Grandparents and Children's Well-Being in sub-Saharan Africa:

Co-residential effects on schooling and stunting

Sandor Schrijner

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Sandor Willem Schrijner
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Promotoren
Prof. dr. E. de Jong
Dr. J.P.J.M. Smits

Manuscriptcommissie
Prof. dr. J. Knoben
Prof. dr. G. L. M. Kraaykamp
Prof. dr. A. Need (Universiteit Twente)

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Chapter 1

Introduction

1.1 Grandparents in the Developing World

A great deal of research in developing countries has been focusing on parents and the relationship with their children. However, the role of grandparents and the relationship with their grandchildren has remained relatively underexposed. With an ageing population ahead and policy-makers wondering how to deal with this issue, the importance of grandparents and elderly in general will increase. Between now and 2050 the estimated share of people of the world population older than 60 years will raise from 12 to 21%. Most of these elderly live in developing countries, currently 62% and an estimated 80% in 2050 (AgeInternational, 2015). While life expectancy is increasing, young and old generations tend to have longer and more frequent contact. For grandparents as well as for their grandchildren these intergenerational relationships can be very important. For grandparents they can provide a feeling that they do matter, which may contribute to their emotional well-being and acknowledgement in society. Grandchildren can also benefit from the support they receive from their grandparents. This might especially be the case under difficult circumstances, as can be found in developing countries. By taking care of their grandchildren, the grandparents do not only support their grandchildren, but also their children, for example by nurturing and baby-sitting, enabling parents to work outside their homes.

In Africa approximately 40% of the adults between 40 and 85 years of age regularly take care of their grandchildren (Weichold, 2009). Particularly in developing countries, where extended household structures are still common practice, grandparents are supposed to play an important role. Intuitively, given the supposed strong bond between mothers and their children, especially their daughters, grandmothers are expected to help them with the care for their grandchildren (Coall & Hertwig, 2010; Hawkes, 2003, 2004; Sear & Mace, 2008). They may help their daughters during their fertile ages, in a period of short birth intervals, facing the workload of raising multiple children.

Regarding grandfathers the situation is considered to be different. Grandfathers are usually associated with more distant and authoritarian ways of involvement than a role as caregiver (Bates & Taylor, 2012; Mann et al., 2015). When (grand)fathers get older, they become more experienced. Their image of leadership and masculinity shifts and they may become more emotionally expressive and affectionate towards their grandchildren. They may wish to teach about interpersonal relationships and to transfer values to their grandchildren (Fuller-Thomson & Minkler, 2001; Waldrop et al., 1999). Such a mentoring and teaching role might become a particularly rewarding experience for grandfathers, if the degree of success of their grandchildren contributes to the level of respect they

gain from their social environment. They might therefore become of greater importance when children are older. While (grand)mothers are supposed to be focused on feeding and caring of young children, (grand)fathers might be more focused on the societal position of their grandchildren. Their social status and masculinity might even to a certain extent depend on the educational achievements of their grandchildren.

It is therefore interesting to take two important periods of a child's life into account, when analysing the role of grandparents with regard to child well-being. First, the period when children are under the age of five. When they are vulnerable to mortality and stunting. In this period the grandmother is expected to play an important role in the lives of their children and grandchildren. Much of the research regarding grandmothers focusses on this period (e.g. Hawkes, 2004; Lahdenperä et al.,2004; Sear et al., 2000). Second, the period when grandchildren have reached primary and secondary school ages (7-15) and the grandfather is expected to play a factor of importance as well. In his role as a teacher and mentor, a grandfather has the possibility to support his grandchildren cognitively and mentally (e.g. Bates, 2009; Waldrop et al., 1999).

Although grandparents are generally seen as a positive factor in the lives of their children and grandchildren, empirical evidence indicates that this is not always the case. Their positive influence is sometimes offset by particular circumstances or even turns into a negative effect. Particularly in resource poor societies, grandparents can become competitors for their grandchildren which might have negative effects on children's well-being (Crookston et al., 2011; Strassmann et al., 2006). For example, body growth rates of girls in Mali are negatively affected by the energetically demanding work they have to perform for their grandmothers in the resource poor society of the Dogon (Strassmann, 2011). Grandmothers might also negatively influence the mortality risks of their grandchildren. Among the Chewa in Malawi child mortality rates are higher in the presence of matrilineal kin. Apparently there are certain conditions that influence the effects of the relationship between grandparents, their children and their grandchildren. These are conditions that are affiliated with the characteristics of the environment in which the relationship between grandparents and their grandchildren is shaped. A better understanding of the 'grandparent effect' may give policymakers the possibility to change or design policy measures aimed at improving the well-being and future possibilities of grandparents and their grandchildren.

This thesis contributes to the field by providing new empirical evidence regarding the role of co-residing grandparents in relation to the well-being of their grandchildren under varying circumstances in sub Saharan Africa (SSA). It looks at how children grow when they are young and whether they go to school

when they are older. Globally an estimated 159 million children under 5 years of age are stunted (being too short for one's age). More than one third of these children is living in Africa. Inadequate nutrition and (infectious) diseases in the first 1000 days of a child's life play an important role in stunting (Black et al., 2013; Unicef, 2007; Unicef et al., 2014; WHO, 2012). The effects of growth retardation on individuals and societies are detrimental in the long run. Important factors for economic development like health, economic productivity, physical and cognitive development, are negatively associated with stunting (Crookston et al., 2011; Hoddinott et al., 2013; Hoddinott et al., 2008; Martorell et al., 2010). Next to stunting another important factor for economic development is schooling. Much research has already been done on the determinants of children's schooling in poor countries (Glick & Sahn, 2006; Huisman & Smits, 2015; Lloyd & Blanc, 1996; Mukherjee & Das, 2008; Smits & Huisman, 2013), but the role of grandparents for children's schooling has received relatively little attention in the literature. Schooling is crucial for economic development as well as for children's prospects in life (Becker, 1962).

This thesis is a major step forward, as it provides -- for the first time -- a broad comparative analysis of the role played by context factors for the relationship between grandparental co-residence and children's well-being, and in particular children's stunting and schooling.

1.2 Theoretical background

In this thesis the role of grandparents in relation to the well-being of their grandchildren is studied by using insights from different disciplines like economics, sociology, anthropology, evolutionary biology and health sciences. These disciplines analyse the behaviour of grandparents towards their (grand) children from different perspectives and attempt, each in their own way, to explain why grandparents to a greater or lesser extent invest in their (grand) children. For example, from an economic perspective (grand) parents have an incentive to invest in their (grand) children. In the absence of a pension system in most developing countries, their (grand) children can be considered as their old age security (Duflo, 2000). Grandparents themselves can be a resource for the household when they are young and still vital, contributing to household production. But when they get old and need care they can also become a net consumer and therefore a burden for households. Other theories concerning grandparental help in rearing offspring find their origin in the socio-anthropological literature. These approaches generally assume a positive effect of grandparental help on children's well-being (e.g. Hawkes 1997, 2004; Hrdy 1999,

2009; Sear & Mace 2000, 2008). Several small scale studies investigate the role of grandparents and in particular the role of the grandmother in relation to child mortality and body growth (stunting) of young children. Evolutionary biology is often used by researchers to explain the role of the grandmother from a reproductive perspective. A famous focal point in this approach is the '*grandmother hypothesis*'. This hypothesis is based on the idea that the evolution of the menopause is to enable grandmothers to take care of their grandchildren to secure their offspring. This argument is supported by evolutionary theory (e.g. Hawkes et al., 1997; Hrdy, 1999, 2009; Sear et al., 2000; Sear, 2008), whereby Hamilton's (1964) inclusive fitness argument plays a central role. According to this argument, individuals can enhance their inclusive fitness by reproducing themselves and/or by helping reproduce other kin with whom they share partly the same genes. When women are getting older, the expected returns on producing offspring themselves may become lower than the returns on helping rearing their grandchildren and other kin in terms of reproduction. In line with this reasoning, the classical grandmother hypothesis argues that the healthy years a woman lives after menopause gives her the opportunity to increase the reproductive success of her children. In this way, she also increases her own reproductive success (e.g. Hawkes et al., 1997; Hawkes, 2004; Lahdenperä et al., 2004).

For grandfathers things are different. Most men are reproductive until their death and do not face diminishing returns on reproduction. They might therefore tend to make a different assessment about whether and when to invest in their existing (grand) children or to invest in new offspring. Grandfathers are usually associated with more distant and authoritarian ways of involvement (Bates & Taylor, 2012; Mann et al., 2015) and have therefore got less attention of researchers in the child survival and health literature. To understand the role of grandfathers, Bates (2009) has built a conceptual framework of g*enerative grandfathering*. At the heart of this framework is the developmental stage of generativity, introduced by Erikson (1963) as one of the eight stages in psychosocial development. In the *generative* stage of life establishing and guiding the next generation forms a central theme. Grandfathering and generativity are connected by Bates through the generative work of grandfathers, which can be described as the efforts grandfathers put forth when nurturing and caring for their offspring. When (grand)fathers get older, they become more experienced. Their image of leadership and masculinity shifts and they become more emotionally expressive and affectionate towards their grandchildren. They wish to teach about interpersonal relationships and to transfer values to their grandchildren (Fuller-Thomson & Minkler, 2001; Waldrop et al., 1999). This mentor and teacher role might be a particularly rewarding experience for grandfathers. The degree of success of their

grandchildren might contribute to the level of respect grandfathers gain from their social environment which can be an incentive for them to invest in their grandchildren. Next to evolved biological incentives, the decision of grandparents to invest in their offspring also depends on the availability of resources.

The *local resource competition hypothesis* (e.g. Borgerhoff Mulder, 2007; Sear and Mace, 2008) predicts that altruistic behaviour of family members may be reduced when there is scarcity of local resources. Several studies support this hypothesis. After questioning the grandmother hypothesis already in 2006 (Strassmann et al., 2006), more recently Strassmann (2011) advanced a new discussion regarding this topic. She argued that under certain conditions grandmother's presence can have a negative impact on children's well-being. In studying the Dogon in Mali, she discovered that co-residence of the paternal grandmother led to a twofold higher hazard of death of the grandchild by the age of 5. This negative effect was even bigger if the paternal grandmother was old and had become a direct competitor of her grandchildren in the resource-poor society of the Dogon. Also the presence of the maternal grandmother was negatively related to child well-being. Although the hazard of death was unaffected by her presence, the body growth rate of Dogon girls (<5 years of age) was negatively affected. A possible explanation for this effect is that body growth was slowed by the energetically demanding work that girls perform for their maternal grandmothers, like fetching water and weeding gardens (Strassmann, 2011, p.10899).

1.3 Stunting and schooling in developing countries

Stunting and schooling are used to analyse the role of grandparents with respect to the well-being of their grandchildren. Schooling can be seen as an activity that influences future benefits through the imbedding of resources in people (human capital) which is crucial for economic development (Becker 1962). This view is supported by firm evidence that education improves individual employment chances, earnings, health status, labour productivity and correspondingly a more competitive economy (Hanushek & Wobmann, 2007; Lutz, Cuaresma, & Sanderson, 2008; UNESCO, 2007). Education is therefore generally seen as an important factor for opportunities children have in later life. Next to building up human capital and cognitive development, stunting is also a relevant factor for economic development and economic productivity (Crookston et al., 2011; Hoddinott et al., 2013; Hoddinott et al., 2008; Martorell et al., 2010). It has been estimated that stunting can reduce a country's GDP by up to 3% (The World Bank, 2006). Children under 5 years of age who are being too short for one's age are

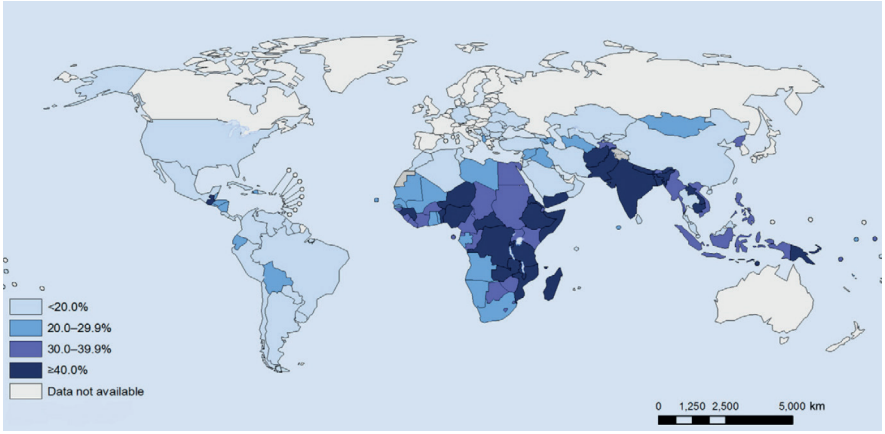
associated with poorer cognitive, educational and health outcomes (Pradhan et. al., 2003; Wamani et. al., 2007; WHO, 1995). Stunting and schooling therefore form a convenient measure for child well-being.

An additional advantage is that stunting and schooling are prevalent factors in different stages of life and together cover much of the juvenile period of children. First, the period when children are under the age of five, when they are vulnerable to mortality and stunting. This is also the period that grandmothers are expected to play an important role in the lives of their grandchildren. Second, the period when children are expected to go to school, which starts around the age of six and grandfathers are expected to play a role of importance as well.

1.3.1 Stunting in developing countries

According to the World Health Organization (WHO), children are stunted when their height-for-age Z-score (HAZ) is two standard deviations below the child growth standard median (WHO, 2012). Globally an estimated 159 million children under 5 years of age are being too short for their age. Almost one third of these children is living in Africa (see figure 1.1). Although the relative figures show a downward trend in the period 1990-2014 (decreased from 42% to 32%), the absolute number of stunted children in Africa has risen from 47 to 58 million in this period due to the high fertility levels. Inadequate nutrition and (infectious) diseases in the first 1000 days of a child's life play an important role in stunting (Black et al., 2013; Unicef et al., 2014; Unicef, 2007; WHO, 2012).

Figure 1.1 Stunting among children under 5: national prevalence estimates for 2012



Source: De Onis et al. (2013)

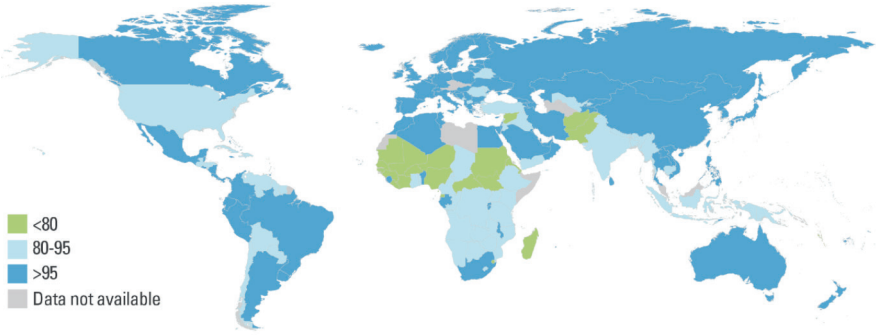
The effects of growth retardation on individuals and societies are detrimental in the long run. Stunting negatively affects important factors for economic development like health, economic productivity, physical and cognitive development (Crookston et al., 2011; Hoddinott et al., 2013; Hoddinott et al., 2008; Martorell et al., 2010).

1.3.2 Schooling in developing countries

Worldwide around 58 million children of primary school age were out of school in 2012. Almost 50% of these children lives in the SSA region. With primary school enrolment rates below 80% (figure 1.2) this continent hosts the world's largest primary school age population that is not in school. Non-participation rates in secondary education are even higher (UNESCO, 2014, 2015).

In most developing countries the decision to invest in schooling of young children, is taken by their parents or grandparents when parents are absent. Their decision is determined by different factors and is subject to changes over time. (Grand)parents weigh off the costs and benefits of the investment in schooling. The benefits are enjoyed generally in the future, in terms of a higher income of their children and therefore better old-age security for themselves. The costs -- which have to be paid now -- concern both direct and indirect costs. Direct costs generally consist of fees, books and pencils, and a school uniform. Indirect costs reflect the costs of not being able to work at home or earn some money with child labour (Webbink, Smits, & de Jong, 2012). These so-called opportunity costs may vary over time, for example during harvest season when they will be higher than

Figure 1.2 Primary school net enrolment rate (%)



Source: UNICEF; retrieved from: data.unicef.org/topic/education/primary-education/# (20-01-2017)

periods when there is less work. The direct and indirect costs are a heavy economic burden for many poor households (Admassie, 2003; Ananga, 2011). The presence of one or more grandparents can in such situations be beneficial to a child's educational participation. Grandparents can compensate the opportunity costs of schooling for their grandchildren, who are not able to contribute to the household. Moreover, grandparents can enable parents to work outside the home or prevent children, especially girls, from taking over household tasks when their mother is working (Huisman and Smits, 2009).

Although much research has already been done on the determinants of children's schooling in poor countries (Glick & Sahn, 2006; Huisman & Smits, 2015; Lloyd & Blanc, 1996; Mukherjee & Das, 2008; Smits & Huisman, 2013) the role of the grandparents for children's schooling has received relatively little attention in the literature. Only a few studies provide some evidence regarding this relationship. For example, Parker and Short (2009) found for Lesotho that it is beneficial for the educational participation of children to live with a grandmother. Zeng and Xie (2014) showed for rural China that the educational level of co-resident grandparents is positively associated with the educational attainment of their grandchildren.

1.4 This thesis, aims and research questions

Although several studies have been conducted on the relationship between the presence of grandparents, child mortality and in a few cases body growth (e.g. Gibson and Mace, 2005; Sear et al., 2000; Borgerhoff Mulder, 2007; Jamison et al., 2002)[1], the effect of the presence of those 'grannies' on educational participation and stunting in developing countries has not yet been assessed in a broad comparative research approach. This is a remarkable observation because we know that schooling and stunting play a vital role in the opportunities of children in their prospective lives (Crookston et al., 2011; Hanushek & Wobmann, 2007; Hoddinott et al., 2008; Lutz et al., 2008; Martorell et al., 2010; UNESCO, 2007). Most of the research so far consists of case studies focusing on one or a restricted number of groups or regions. These studies may provide in-depth understanding of the situation of those groups or regions, but give less insight into the role of the context in which households are situated. To study the role of context factors in an effective (multivariate) way, information is needed on a large number of contexts and within each context on a large number of households. Such a huge multilevel database, with many households in many contexts, has not yet been used in research on the role of grandparents in Africa.

1 For a broad overview see meta-analysis of Strassman & Garrard (2011) and Sear & Mace (2008)

The approach in this thesis is therefore a major step forward because it studies the influence of context factors on the grandparental effect at the level of almost 1200 sub-national regions -- and at the level of around 30.000 communities – within more than 30 countries. The aim is to understand the relationship between the presence of grandparents and the well-being of their grandchildren and how it varies under different circumstances. It uncovers the relationship between co-residing grandparents and the schooling and stunting of their grandchildren in families in SSA countries, under a broad range of circumstances.

Another step forward is the focus on the role of grandparents related to stunting and schooling. Research studying the role of grandparents related to the stunting and schooling of their grandchildren is very limited. There are a few studies examining the difference in school attendance between orphans and non-orphans in Africa, but in most of these studies grandparents play a minor role (e.g. Bicego et al., 2003; Nyambedha et al., 2003; Nyamukapa & Gregson, 2005; however see Parker & Short, 2009 for an exception). The role and influence of grandparents with respect to the stunting of their grandchildren has received little attention as well. Gibson and Mace (2005) for example found that non-reproductive maternal grandmothers in Ethiopia were positively associated with child height. According to the findings of Strassmann (2011: p.10899) Dogon girls tend to grow faster in the absence of the maternal grandmother. Given the close connection between mothers and young children, especially in the period of early childhood, initially much research in the field of stunting has been focusing on mother's behavior and her characteristics. This is regrettable because most mother-child dyads are not self-contained units, but are part of an extended family system in which mothers are supported and influenced by other family members and in particular by grandmothers (Aubel, 2012).

As previously indicated, both positive and negative effects of grandparental co-residence on child well-being have been found in the literature. The size and direction of these effects is therefore supposed to be influenced by the circumstances under which the households live. I will study how the contribution of the grandparents to the well-being of their grandchildren is influenced by socio-economic, demographic and cultural factors at household and context level using interaction analysis. The effects on the major outcome variables, children's educational participation and body growth (stunting), will be analyzed by using data with detailed information on family structure and socio-economic indicators like education, occupation and wealth.

By applying multilevel logistic regression analysis, I aim to answer the following research questions:

1. What is the relationship between grandmother's co-residence and their grandchildren's schooling in sub-Saharan Africa? How is this relationship moderated by household and context characteristics?

2. To what extent and in what way does the effect of co-residing grandmothers on the schooling of their grandchildren differ between paternal and maternal grandmothers? How is this relationship moderated by household and context characteristics?

3. What is the relationship between grandfather's co-residence and their grandchildren's schooling in sub-Saharan Africa? How is this relationship moderated by household and context characteristics?

4. What is the relationship between grandmother's and grandfather's co-residence and the growth of their grandchildren (stunting) in sub-Saharan Africa? How is this relationship moderated by household and context characteristics?

1.5 The research model

The research model used in this study is presented in figure 1.3. It forms a reflection of mechanisms found in different academic disciplines like economics, sociology, anthropology and evolutionary biology related to grandparents and the well-being of their grandchildren. An important assumption in this thesis is that grandparents who are already living with their grandchildren have a low threshold to invest in their grandchildren compared to grandparents who are not living with their grandchildren. Box 1 discusses some important reasons for grandparents to reside with their grandchildren. Co-resident grandparents are physically present in the household and are expected to consider it as their (normal) duty to contribute to the household and child rearing. The way they contribute to their grandchildren's well-being is expected to differ between grandmothers and grandfathers (see figure 1.3).

Grandmothers can compensate the opportunity costs of schooling of their grandchildren, who are not able to contribute to the household. They can enable parents to work outside the home or prevent children, especially girls, from taking over household tasks when their mother is working (Huisman and Smits, 2009). In addition, most mother-child dyads are not self-contained units, but are part of

an extended family system in which mothers are supported and influenced by other family members and in particular by grandmothers: the grandmother-mother-child triad. Grandmothers are experienced in raising offspring. They can advise and support their children in raising their grandchildren and perhaps prevent them from being stunted. This is particularly useful when their daughter (-in-law) is young and has to (breast)feed and take care of multiple children.

Box 1 Why grandparents are living with their grandchildren

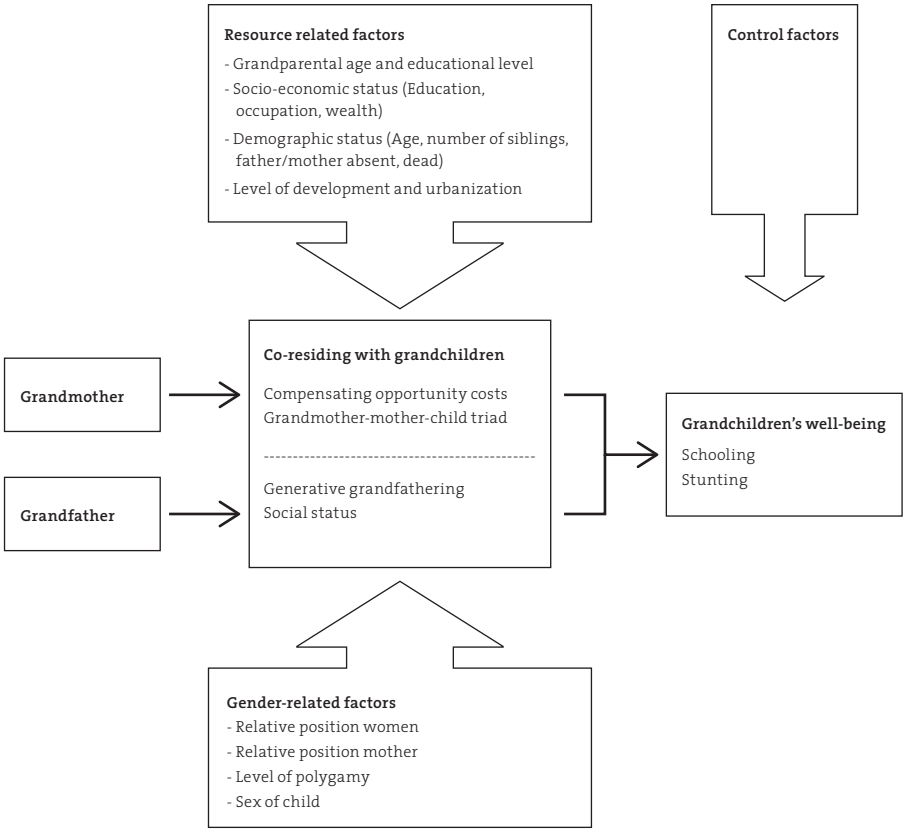
To increase our understanding of the role played by co-residing grandparents with respect to the schooling and stunting of their grandchildren, it is important to have some insights in why grandparents reside with their (grand) children. In the African context, the reasons for this are diverse. In some regions and among some groups the cultural tradition exists that one or more children remain living with their parents after marriage (e.g. Kandiyoti, 1988; Fox, 1967; Korotayev, 2003). The partners of these children then come to live in the family home and become a member of the extended family system. Under poor circumstances, sharing costs of living in this way increases survival chances and care needs can be fulfilled more easily. Living together with their children also constitutes a natural old-age security system for the (grand)parents (Laferrère and Wolff, 2006). Over time, the situation may gradually change from one in which the grandparents are the major driving forces of the household to one in which the next generation takes over. The grandparents then become the helping hands, as long as their health allows this.

Another way in which (grand)parents and children may come to live together is when children after marriage establish their household elsewhere, but the grandparents move in later. This might for example be for financial reasons, because the grandparents need care, or because one of them has died. Depending on the health status of the (grand)parents, they may then be a resource or a burden for the household.

Still another possibility is that children come to live with their grandparents because their parents are dead or ill. When parents die, grandparents are usually the ones that take over the care for their grandchildren. In SSA, where overall mortality levels are high and an estimated 15 million children have lost one or both of their parent(s), this is a very common situation (UNAIDS, 2013). Depending on the circumstances, the child may move to the household of the grandparent(s) or the grandparent(s) may come to live in the parental home.

This line of thought is supported by evolutionary theory (e.g. Hawkes et al., 1997; Hrdy, 1999, 2009; Sear et al., 2000; Sear, 2008), whereby Hamilton's (1964) inclusive fitness argument plays a central role. According to this argument, individuals can enhance their inclusive fitness by reproducing themselves and/or by helping other kin with whom they share (partly) the same genes. When women are getting older, the expected returns on producing offspring themselves may become lower than the returns on helping rearing their grandchildren and other kin in terms of reproduction. In line with this reasoning, the classical grandmother hypothesis argues that the healthy years a woman lives after the menopause gives her the opportunity and an incentive to increase the reproductive success of

Figure 1.3 Conceptual model of relationship between grandparental co-residence and their grandchildren's well-being in SSA



her children, because in this way she also increases her own reproductive success (e.g. Hawkes et al., 1997; Hawkes, 2004; Lahdenperä et al., 2004).

To understand the role of grandfathers, a conceptual framework of g*enerative grandfathering* designed by Bates (2009), has been used in this thesis. At the heart of his conceptual framework of g*enerative grandfathering* is the developmental stage of 'generativity', introduced by Erikson (1963) as one of the eight stages in psychosocial development. In the *generative* stage of life, establishing and guiding the next generation forms a central theme. Grandfathering and generativity are connected by Bates through the generative work of grandfathers, which can be described as the efforts grandfathers put forth when nurturing and caring for their offspring. This involves lineage work, spiritual work, recreation work, family identity work, and investment work (Bates, 2009). Some of these forms of generative work may have a direct effect on schooling such as 'mentoring work' or 'investment work'. According to Bates & Taylor (2012) contact frequency and participating in activities are key elements of a positive grandfather role and co-residing grandfathers are in the best situation for having a high contact frequency and participate in activities with their grandchildren.

When (grand)fathers get older, they become more experienced. Their image of leadership and masculinity shifts and they may become more emotionally expressive and affectionate towards their grandchildren. They may wish to teach about interpersonal relationships and to transfer values to their grandchildren (Fuller-Thomson & Minkler, 2001; Waldrop et al., 1999). Such a mentoring and teaching role might become a particularly rewarding experience for grandfathers, if the degree of success of their grandchildren contributes to the level of respect they gain from their social environment.

Given the variation in grandparental effects found in previous research, an important focus of this thesis is on the role of the circumstances. To what extent and in which way the effect of a co-residing grandparent influences children's well-being is supposed to depend on the age and educational level of the grandparents and on specific characteristics of the household and the context in which the household is situated. These factors are divided into resource-related factors and gender-related factors (see figure 1.3). Resource related factors are for example income, wealth, education and employment. Gender related factors concern the relative position of women, gender of the child and level of polygamy. Next to the moderating factors, control factors that are known from the literature to have an effect on schooling and stunting are added to the model.

1.6 Overview of chapters

The remainder of this thesis is structured as follows. The substantive part of this thesis starts in Chapter 3. In general grandmothers are seen as important caregivers with respect to their children and grandchildren. Therefore, the starting point of examining the relationship between grandparents and children's well-being, is a study of the role of co-residing grandmothers related to their children and grandchildren. Table 1 outlines the structure of the empirical part of this thesis.

Table 1.1 Content of thesis

Chapter	Research question	Dependent variable	Independent variable*	Data & Design
3	How does the effect of a co-residing *grandmother* vary under different socio-economic and demographic circumstances?	Schooling of children (7-15 years)	Co-residence grandmother	DHS-household survey data, 33 countries (n=917.788), Multi-level logistic regression
4	How does the effect of a co-residing grandmother differs between *maternal* and *paternal* grandmothers?	Schooling of children (7-15 years)	Paternal versus Maternal grandmother	DHS-household survey data, 33 countries (n=917.788), Multi-level logistic regression
5	How does the effect of a co-residing *grandfather* vary under different socio-economic and demographic circumstances?	Schooling of children (7-15 years)	Co-residence grandfather	DHS-household survey data, 33 countries (n=917.788), Multi-level logistic regression
6	How does the effect of a co-residing *grandfather* and/or *grandmother* vary under different socio-economic and demographic circumstances?	Stunting of children (6-60 months)	Co-residence grandmother, grandfather	DHS-household survey data, 31 countries (n=357.340), Multi-level logistic regression

* Focus variable. Other independent variables: age and education (grand)parents, age & gender child, birth order, number of sisters and brothers, presence parents (dead or alive, but not in household), household wealth, workstatus & age difference mother and father, polygamous household, living in rural area, level of polygamy, development and education, position women.

In chapter 3 I take a closer look at the role of grandmothers in SSA in general and in particular regarding their role related to children's schooling under varying circumstances. Chapter 4 digs deeper into this relationship and explores the differences between maternal and paternal grandmothers with respect to the schooling of their grandchildren, whereby testing the *confidence of paternity hypothesis* which predicts maternal grandmothers to invest more in their grandchildren than paternal grandmothers (Gaulin & Schlegel, 1980; Strassmann & Garrard, 2011). In chapter 5 the association between co-residing grandfathers and children's schooling is analysed under varying circumstances using the framework of *generative grandfathering* (Bates, 2009). Chapter 6 analyses the role of co-residing grandparents in relation to children's stunting. Based on the results and conclusions of the previous chapters, the research questions of this thesis are answered as far as possible in chapter 7. These findings also form the basis for discussing the shortcomings of this thesis and recommendations for future research. The next chapter, chapter 2, describes the data and method used in this thesis.

Chapter 2

Data and Method

2.1 Introduction

This chapter describes the data and method that is used in this thesis. Section 2.2 gives a general introduction of the Demographic and Health Surveys from which the datasets are derived. It also gives an overview of the country data that is included in the analysis of the 'schooling' part (chapters 3,4 & 5) and the 'stunting' part (chapter 6). In section 2.3 the data and most important variables regarding these parts are discussed and described in more detail. Section 2.4 explains the method used in the analyses.

2.2 Demographic and Health Survey Data

For this study, combined datasets from the African Demographic and Health Surveys (DHS) have been used (DHS; www.dhsprogram.com). The data are derived from the Database Developing World (www.datdevworld.org). DHS are large, nationally representative household surveys, sponsored by USAID. For each survey, non-overlapping area units (often enumeration areas) are randomly selected. These areas (called 'clusters' henceforth) are usually communities, villages, or city quarters. In the selected clusters, all households are listed and a random sample of 25-30 households is selected for the interviews. The DHS consist of a household survey, in which basic information is collected of all household members, and separate women's and men's surveys. In the women's surveys, all usual resident women aged 15 to 49 are invited for an oral interview. In this interview, information is obtained on socioeconomic, demographic, and health related issues[2].

The household level data have also been used for deriving context information at the level of districts and communities/clusters. To get representative samples of the countries, the household weights provided by DHS have been used in all analyses. To get a maximum discriminatory power, the data of the available DHS surveys for SSA countries held since 2000 have been pooled. However, for South Africa and Togo data from 1998 have been used as at the start of the project no other DHS surveys for these countries were available. Table 2.1 gives an overview of the country data used in this thesis. For the majority of the countries the data of multiple years are pooled. Response rates are generally high, over 95% in most surveys.

2 For more detailed information check the 'Guide to DHS Statistics' at http://dhsprogram.com/publications.

Table 2.1 DHS country data, year of survey(s) and household response rates

Country	Year(s)	HH Resp. rate (%)
Benin	2001, 2006, 2011	97.0, 99.1, 98.6
Burkina Faso	2003, 2010	99.4, 99.2
Burundi	2010	99.1
Cameroon	2004, 2011	97.6, 99.0
Chad	2004**	99.4
Cote d'Ivoire	2005, 2011	95.5, 98.1
Congo DR	2007, 2013	99.3, 99.9
Congo Brazzaville	2005, 2011	99.2, 99.8
Ethiopia	2000, 2005, 2011	99.3, 98.5, 98.1
Gabon	2000**, 2012	97.6, 99.3
Gambia	2013*	95.0
Ghana	2003, 2008, 2014*	98.7, 98.9, 98.5
Guinea	2005, 2012	99.2, 99.5
Kenya	2003, 2008, 2014*	96.3, 97.7, 99.0
Lesotho	2004, 2010	95.2, 97.6
Liberia	2007, 2013	97.2, 99.4
Madagascar	2004, 2009	97.8, 98.8
Malawi	2000, 2004, 2010	99.0, 97.8, 98.1
Mali	2001, 2006, 2013	97.9, 98.8, 98.4
Mauritania	2001**	98.4
Mozambique	2003, 2011	80.6, 99.8
Namibia	2000, 2006, 2013	96.9, 97.8, 96.9
Niger	2006, 2012	98.0, 98.0
Nigeria	2003, 2008, 2013	98.6, 98.3, 99.0
Rwanda	2000, 2005, 2010	99.7, 99.7, 99.8
Senegal	2005, 2011, 2012	98.5, 98.4, 98.7
Sierra Leone	2008, 2013	97.6, 99.3
South Africa	1998**	97.0
Swaziland	2006	95.2
Tanzania	2004, 2010	98.8, 98.8
Togo	1998**, 2014*	98.6, 99.1
Uganda	2001, 2006, 2011	95.8, 95.3, 97.5
Zambia	2002, 2007, 2014*	98.2, 97.8, 97.9
Zimbabwe	2006, 2011	95.0, 96.0

* Only in chapter 6
** Only in chapters 3,4 and 5

2.3 Datasets used in this thesis

The dataset used in the chapters 3,4 and 5 combines 69 DHS-surveys and contains information of 917.788 children (467.528 boys and 450.260 girls). The children are 7–15 years old and living in 29.925 local communities (sample clusters) within 1164 sub-national regions (sample districts) of 33 SSA countries. Regarding chapter 6 the combined dataset contains information derived from 69 DHS-surveys of 345.026 children (171.669 girls and 173.357 boys) aged 6-60 months living in 31.014 local communities within 1156 sub-national regions of 31 SSA countries.

2.3.1 Dependent variable Schooling (chapter 3,4 & 5)

The dependent variable 'educational participation' is a dummy variable indicating whether (1) or not (0) children aged 7–15 were attending school at the time of the interview. The upper age limit of 15 is chosen because above that age less children are living with their parents (e.g. because of early marriage, education, or parental death). The lower age limit is set at 7, because in most SSA countries a substantial number of children start schooling at a later than compulsory age (Huisman and Smits, 2009).

2.3.2 Dependent variable Stunting (chapter 6)

The dependent variable 'stunting' is a dummy variable indicating whether (1) or not (0) children under the age of five were stunted at the time of the interview. Children are stunted when their height-for-age Z-score (HAZ) is two standard deviations below the WHO child growth standard median (WHO, 2012). Stunting information is derived from the women surveys which are part of the DHS-household surveys. As a consequence there are no children with a missing mother in the sample.

2.3.3 Independent variables

The major independent variables are two dummy variables indicating whether (1) or not (0) children are living with: 1. their grandmother or 2. their grandfather. Children co-resident with their grandparents are identified in the DHS-data by using the household roster, which defines for all household members their relationship to the household head.

Children are identified as living with a grandmother if (1) they are grandchildren of a female household head; (2) they are grandchildren of a male household head whose wife is also living in the household; (3) they are children of the household head, and the mother or mother in law of the household head is also living in the household; (4) they are children of a brother or sister of the household head, and the mother of the household head is also living in the household.

Children are identified as living with their grandfather if (1) they are grandchildren of a male household head; (2) they are grandchildren of a female household head whose husband is also living in the household; (3) they are children of the household head, and the father or father in law of the household head is also living in the household; (4) they are children of a brother or sister of the household head, and the father of the household head is also living in the household. All other children living in the household, including adopted and foster children, are considered as not living with their grandfather or grandmother. Given the restricted information on the relationships within the households, it cannot be completely precluded that some of these children still live together with a grandfather or grandmother, for example if they belong to the categories "Other family members" or "Not related household members". However, given that the number of school-aged children in the data who belong to these categories is very small (3%), the number of them living with their grandparent(s) is expected to be negligible.

Other important independent variables are age and educational level of grandparents and parents, measured in years. The presence of each parent is measured with two dummies, one indicating whether (1) or not (0) the parent is absent from the household and one indicating whether (1) or not (0) the parent is dead. Age of the child and age of its (grand)parents are interval variables. The variables 'number of sisters' and 'number of brothers' are also interval variables ranging from 0 to '10 or more'. This is also the case concerning the values of 'birth order' which run from 0 to '18 or more'.

The models contain a number of control factors that are known or can be expected to influence children's educational participation and stunting. Household wealth, father's occupation, parental education and employment of the mother are factors that have been known to influence children's educational participation and body growth (Evangelista de Carvalho Filho, 2012; Glewwe & Jacoby, 2004; Mingat, 2007; Shavit & Blossfeld, 1993; Smits & Gündüz-Hoşgör, 2006). Other control factors that are known to influence body growth are receiving vaccinations and vitamin A in the first two months after delivery and birth size (Berendsen et al., 2016; Espo et al., 2002).

Because income is lacking in the DHS data, household wealth was measured by the International Wealth Index (IWI; Smits and Steendijk, 2015), a comparative asset-based wealth index. IWI indicates to what extent the household owns a basic set of assets, valued highly by people across the globe, such as TV's, cars, telephones and housing characteristics like the quality of the floor material and toilet facility. Occupation of the father is measured by three dummy variables, indicating whether (1) or not (0) the father was employed in a farm, lower non-farm (sales, services, manual), or upper non-farm (professional, technical,

managerial, clerical) occupation. Employment of the mother is measured by a dummy variable indicating whether (1) or not (2) the mother aside from her housework did any other work last week.

To indicate the relative position of the mother in the household I follow earlier research (Blanc & Wolff, 2001; Luz & Agadjanian, 2015; Spierings et al., 2010) and use the age difference between parents (age mother minus age father).

To study the importance of context factors, socio-economic characteristics (level of development, urbanization, education) and gender related cultural characteristics (age difference between spouses, polygamy) of the region have been added to the models. Level of development is indicated by the mean of the International Wealth Index in the region. Given that this index at the national level is highly correlated with the Human Development Index and with GNP per capita (Smits and Steendijk, 2015) it is expected to be a good development indicator at the sub-national level as well. Urbanization is measured by a dummy variable indicating whether (1) or not (0) the household is living in a rural area. Education is measured by the mean years of education of people aged 20-40 in the area. The relative position of women in the context where the household lives is indicated by the average age difference between parents as an interval variable and by the percentage of polygamous households in the area. Polygamous households are households where the male household head has more than one wife.

Given that for African countries hardly any indicator is available at the sub-national level, context factors are created by aggregating DHS-household level variables to the sample cluster and district level. Sample clusters are villages or neighbourhoods and therefore reflect the nearby community in which the household lives very well. Using context variables at the cluster level therefore seems preferable over using such variables at the more distant district level. However, the sample clusters in the data are rather small (at most 30 households and often much less). This means that there is little variation at that level and measurement is less precise. At the district level, sample sizes are much larger. Evidence suggests that context effects can be caught rather well by more distant variables (Smits, Keij-Deerenberg, & Westert, 2005), although education at cluster level forms an exception. Kravdal (2006) found that the context level of education works well at cluster level. I therefore include context education at cluster level and the other context factors at district level.

2.4 Method

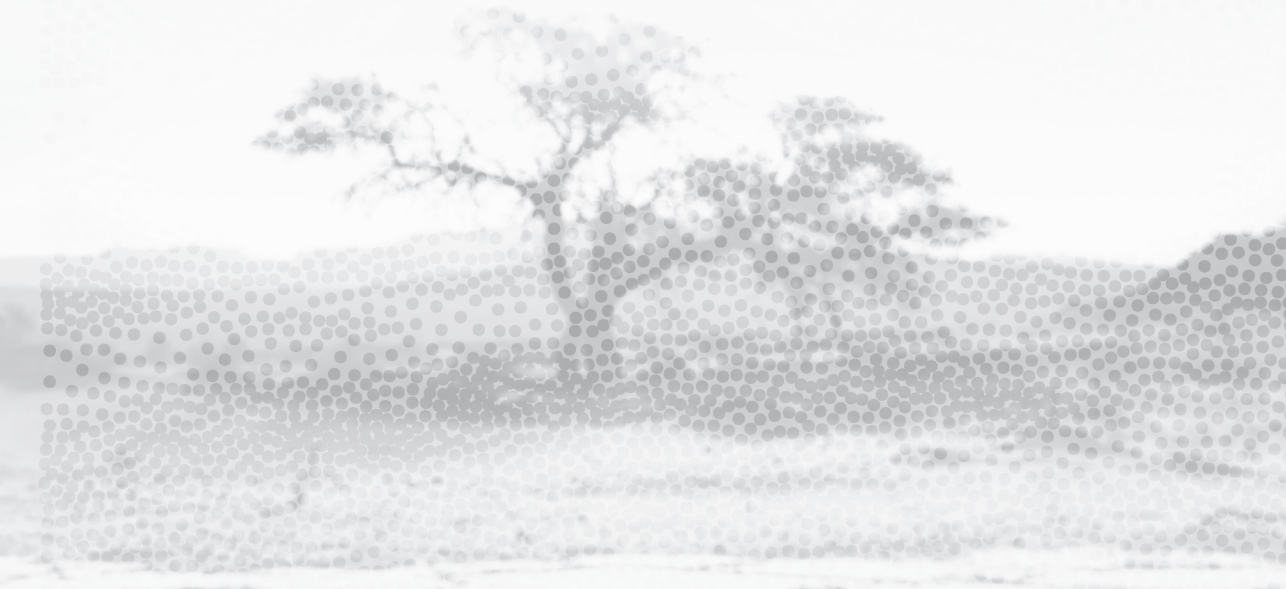
The datasets are characterized by a hierarchical structure. Households are nested within clusters, nested within districts, nested within countries. Three-level logistic regression analysis is used to address the nesting of the households within clusters and districts. Fixed effects dummies at the national level are included to control for the nesting within countries. This strategy allows to fully control for clustering and confounding at the national level, while retaining the possibility to study the role of context factors at the district and cluster level. The models in this thesis are estimated with MLwiN 2.32, using second-order penalized quasi-likelihood (PQL2), the recommended estimating technique for multilevel logistic regression analysis (Goldstein and Rasbash, 1996).

Structural missings on the characteristics of parents and grandparents who were absent from the household (e.g. education or occupation of a death father) are addressed by using the dummy variable adjustment procedure, which leads to unbiased estimates of these variables (Allison, 2001; Little and Rubin, 2002). To control for the fact that the surveys are held in different years and that for most countries several surveys were brought together, an indicator for 'survey year' is included in the analysis.

To find out whether and in which ways the effect of a co-residing grandmother or grandfather differs across circumstances, interactions between the grandmother or grandfather dummy and all other variables at household and context level are tested. In this interaction analysis, centred versions of the involved variables are used, so that the main effects can be interpreted as average effects (Jaccard & Turrisi, 2003). Only the significant results of the interaction analysis are reported.

Chapter 3

Grandmothers and Children's Schooling in sub-Saharan Africa [3]



3 Based on Schrijner, S., Smits, J., (forthcoming). *Grandmothers and Children's Schooling in sub-Saharan Africa*, Human Nature.

Abstract

Under poor circumstances, co-residence of a grandmother is generally considered to be beneficial for (grand)children. Empirical evidence does not unequivocally support this expectation and suggests that grandmother's importance depends on the circumstances the family is living in. In this chapter I study the relationship between grandmother's co-residence and children's schooling in sub-Saharan Africa under a broad range of circumstances.

The results make clear that the effect of a co-residing grandmother varies, but is almost always positive. Grandmothers over age 60 are most effective in helping their (grand)children. They are particularly important for girls and when the mother is dead or missing in the household. Grandmothers are less effective in situations with few opportunities, like in very poor regions or in communities with few schooling possibilities.

The findings indicate that support to grandmothers should not be overlooked when designing policies aimed at strengthening the position of women and children in the sub-Saharan African context.

3.1 Introduction

An important topic in family research concerns the benefits children in poor countries derive from the presence of a grandmother in the household. The prevalent view that grandmothers are beneficial for their grandchildren, is supported by a number of studies (Hawkes et al., 1997; Hrdy, 1999; Sear et al., 2000; Sear & Mace, 2008). However, there are also scholars who found negative or null effects of grandmothers on the well-being of their grandchildren (Jamison et al., 2002; Voland & Beise, 2002). A recent example is a study of Strassmann (2011), who reported that among the Dogon in Mali the presence of a grandmother had adverse effects on the lives of their young grandchildren. Co-residence of the paternal grandmother was associated with a twofold higher hazard of death of a grandchild by the age of five. One of the explanations given was that older grandmothers may become net-consumers and therefore compete with their grandchildren in the resource-poor society of the Dogon. Strassmann (2011) also noticed that girls tend to grow slower in the presence of the maternal grandmother. These findings indicate that there are circumstances under which grandmothers' co-residence may have a negative impact on child well-being. This is a critical finding in light of the fact that in sub-Saharan Africa (SSA) an estimated 15.1 million children have lost one or both of their parent(s) and that many of them have become highly dependent on the care of their grandmother(s) (UNAIDS, 2013). For designing policies aimed at improving the life chances of these children, it is important to find out under which circumstances co-residence of grandmothers is more or less positive for their grandchildren's well-being. This study contributes to the field by providing new empirical evidence regarding the association between grandmothers' co-residence and children's schooling and how this association is moderated by characteristics of the context in which the household is living.

Most of the literature so far consists of case studies focusing on one or a restricted number of groups or regions (e.g. Parker & Short, 2009; Gibson & Mace, 2005; Sear et al., 2000; Strassmann, 2011). These studies may provide an in-depth understanding of the situation of those groups or regions, but give less insight into the role of the context in which households live. To study the role of context factors in an effective (multivariate) way, information is needed on a large number of contexts and within each context on a large number of households. Such a huge multilevel database, with many households in many contexts, has not yet been used in research on the role of grandmothers in Africa.

Another restriction of the literature so far is that it is almost completely focused on relationships between grandmother's co-residence and health outcomes, like infant and child mortality and body growth (e.g. Borgerhoff Mulder, 2007;

Jamison et al., 2002; Gibson and Mace, 2005; Sear et al., 2000; for a broad overview see also Strassmann and Garrard, 2011 and Sear and Mace, 2008). Research focussing on schooling is very limited. There are a few studies examining the difference in school attendance between orphans and non-orphans in Africa, but in most of these studies grandmothers play a minor role (e.g. Bicego et al., 2003; Nyambedha et al., 2003; Nyamukapa & Gregson, 2005; however see Parker & Short, 2009 for an exception). This is regrettable, as going to school is essential for the opportunities of children in their prospective lives. In SSA, still 22% of the primary school age population is not in school and non-participation rates in secondary education are even (much) higher (UNESCO, 2014). Gaining insight into the importance of a co-residing grandmother for children's schooling and in particular into the circumstances under which this role is most beneficial is therefore of great importance.

To study the relationship between grandmother's co-residence and children's schooling in SSA, I have built a new database with information on more than 900.000 children aged 7-15, living in 33 countries. By applying multilevel logistic regression analysis on this database, I aim to answer the following research questions:

1. *What is the overall relationship between grandmother's co-residence and their grandchildren's educational participation in sub-Saharan Africa?*
2 *To what extent and in which way is this relationship influenced by situational factors, like the age of the grandmother and resource and gender related characteristics of the household and the context in which the household is living?*

A major step forward of this approach is that the influence of context factors on the grandmother effect is studied at the level of 1164 sub-national regions -- and for one factor even at the level of 29.925 communities – within the 33 countries. This means that there is considerable power to study effects of context factors in a multivariate way and questions about the role of the context can be answered better than in earlier studies.

In the next section, the importance of education and the reasons why grandmothers in SSA may be living with their (grand)children are discussed. Then in section 3.3 the theoretical framework that is used to guide this research is presented and hypotheses are formulated. Section 3.4 describes the data and methods used in the analysis. In 3.5 the results are presented. Concluding remarks are given in section 3.6.

3.2 Background

Grandmothers and schooling

Schooling can be seen as an activity that influences future benefits through the imbedding of resources in people. Which is also called investing in human capital. Next to physical capital, human capital is crucial for economic development as well as for children's prospects in life (Becker, 1962). Although much research has already been done on the determinants of children's schooling in poor countries (Glick & Sahn, 2006; Huisman & Smits, 2015; Lloyd & Blanc, 1996; Mukherjee & Das, 2008; Smits & Huisman, 2013) the role of the grandmother for children's schooling has received relatively little attention in the literature. Only a few studies provide some evidence regarding this relationship. For example, Parker and Short (2009) found for Lesotho that it is beneficial for the educational participation of children to live with a grandmother. Zeng and Xie (2014) showed for rural China that the educational level of co-resident grandparents is positively associated with the educational attainment of their grandchildren.

There is also research comparing grandparent-headed households and households headed by other relatives regarding schooling outcomes. Children of grandparent-headed households in Malawi, Mozambique and Zambia have better educational outcomes than those living in households headed by other relatives, such as an aunt or niece (e.g. Ainsworth et al., 2005; Case et al., 2004; Nyamukapa and Gregson, 2005). Other studies investigate the difference in school attendance between orphans and non-orphans (e.g. Bicego et al., 2003; Nyambedha et al., 2003; Nyamukapa & Gregson, 2005), but in these studies grandmothers play a minor role. Broad comparative research that can learn us how the relationship between grandmothers' co-residence and children's schooling varies across circumstances is completely lacking for Africa, as well as for other low-income contexts.

3.3 Theoretical framework

Grandmothers: a drain or a resource?

The framework used in this study is presented in Figure 3.1. Grandmothers' co-residence is the major independent variable and educational participation the dependent variable. I hypothesize that the effect of grandmothers' co-residence on their grandchildren's schooling is positive (arrow A). This *grandmother co-residence hypothesis* is based on the expectation that grandmothers who are already living with their grandchildren have a low threshold to invest in their grandchildren. They are physically present in the household and consider it as

their normal duty to contribute to the household and child rearing. Additionally, from a biological perspective, grandmothers may be predisposed to invest in their grandchildren. This argument is supported by evolutionary theory (e.g. Hawkes et al., 1997; Hrdy, 1999, 2009; Sear et al., 2000; Sear, 2008), whereby Hamilton's (1964) inclusive fitness argument plays a central role. According to this argument, individuals can enhance their inclusive fitness by reproducing themselves and/or by helping reproduce other kin with whom they share partly the same genes. When women are getting older, the expected returns on producing offspring themselves may become lower than the returns on helping to rear their grandchildren and other kin in terms of reproduction. In line with this reasoning, the classical grandmother hypothesis argues that the healthy years a woman lives after menopause gives her the opportunity to increase the reproductive success of her children. In this way, she also increases her own reproductive success (e.g. Hawkes et al., 1997; Hawkes, 2004; Lahdenperä et al., 2004).

Grandmothers might also be a burden to the household resources. The *local resource competition hypothesis* (e.g. Borgerhoff Mulder, 2007; Sear and Mace, 2008) predicts that altruistic behaviour of family members may be reduced when there is scarcity of local resources. Several studies support this hypothesis. Strassmann (2011) found the co-residence of a paternal grandmother to lead to a twofold higher hazard of death of a grandchild by the age of five. She attributes this to the fact that old grandmothers become net-consumers and therefore competitors for their grandchildren in the resource-poor society of the Dogon. Sear (2008) discovered that among the Chewa in Malawi child mortality rates are higher in the presence of matrilineal kin and in particular in the presence of the maternal grandmother. Sear supposed this negative effect to be caused by resource competition between kin. Borgerhoff Mulder (2007) also observed, using within-population variation in land ownership in Kenya, that wealth affects the extent of kin altruism. Paternal relatives (specifically father's brothers) appear to buffer young children from mortality much more effectively in rich than in poor households. However, in case of resource conflicts paternal grandmothers seem to improve child survival. To what extent there is a positive grandmother effect on children's schooling might thus depend on the circumstances, with the effect being weaker when the grandmother is old or when the household is living under poor circumstances.

Grandmothers and child survival

There are many studies analysing the associations between the presence of a grandmother and the physical well-being of their grandchildren. Hawkes et al. (1997) for example observed that Hadza-grandmothers in Tanzania appear to enhance the nutritional welfare of grandchildren by helping their daughters in

provisioning food for the children. In rural Gambia maternal grandmothers seem to double the survival chances of a Mandinka child by taking care of their grandchildren (Sear et al., 2000). For paternal grandmothers no effects were found. Ethiopian grandmothers had a positive effect on child survival by relieving their daughters of heavy domestic work. Non-reproductive maternal grandmothers in Ethiopia were positively associated with child height (Gibson and Mace, 2005). However, when studying the Kipsigis in Kenya, Borgerhoff Mulder (2007) found no positive effect of maternal grandmothers, which she associated with the strong patrilineal organization of the Kipsigis. In case of resource conflicts, paternal grandmothers seem to improve child survival. Strassmann (2011) found no positive maternal grandmother effects. Dogon girls tend to grow faster in the absence of the maternal grandmother. According to Strassmann (2011: p.10899) this is probably the result of the hard work they have to perform for their grandmother, like weeding in the garden.

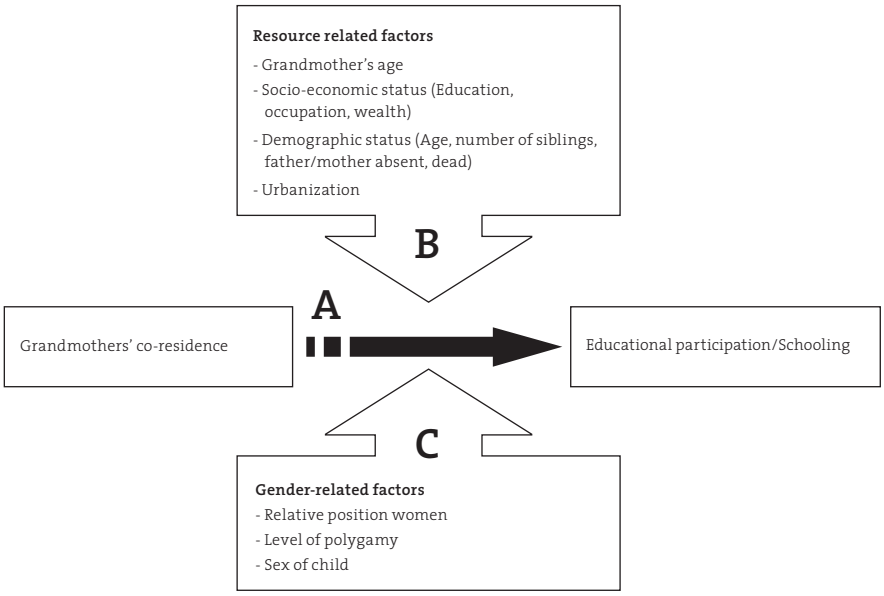
Studies in more affluent contemporary societies, like the U.S. and Europe, generally show a positive role of grandmothers (e.g. Danielsbacka et al., 2011; Dimova and Wolff, 2010; Fuller-Thomson and Minkler, 2001; Hank and Buber, 2008; Kaptijn et al., 2013), whereby the grandmothers for example delivered childcare or helped their (grand)children financially. For pre-modern societies, findings are more mixed (e.g. Beise, 2005; Jamison et al., 2002; Lahdenperä et al., 2004; Voland and Beise 2002). Lahdenperä et al. (2004) found that the presence of grandmothers in 18th and 19th century Finland and Canada was associated with less mortality among their grandchildren, but that the significance of this effect depended on grandmother's and grandchildren's age. When a grandchild was aged between two and five and grandmothers were under 60 years of age when their grandchildren were born, survival probabilities were significantly higher. Using historical data (1671-1871) of a small village in Japan (Shumon Aratame Cho), Jamison et al. (2002) noted a positive association between the presence of a maternal grandmother and child survival rates. Presence of a paternal grandmother, on the other hand, was negatively associated with the survival of boys.

The role of the circumstances

Given the variation in grandmother effects found in previous research, the main focus in this chapter is on the role of the circumstances; to what extent and in which way the effect of a co-residing grandmother varies, depends on the age of the grandmother and on specific characteristics of the household and the context in which the household lives (research question 2). This role of situational factors is represented in Figure 3.1 by the arrows B and C, which show the factors that moderate the grandmother effect (Arrow A). These factors include resource-

related factors and gender-related factors. In the next section, these factors and other control variables are discussed.

Figure 3.1 Conceptual model of relationship between grandmothers' co-residence and children's schooling in SSA



Resource related factors

As discussed before, the local resource competition hypothesis (Borgerhoff Mulder, 2007; Sear & Mace, 2008) emphasizes the negative effects on altruistic behaviour of family members due to scarcity of local resources. In a resource-poor environment, a grandmother may easily become a competitor of her grandchildren, especially when she is old and needs to be taken care of (compare Strassmann, 2011). There is also evidence that the survival probabilities of children in 18th and 19th century Finland and Canada were significantly higher when their grandmothers were under 60 at their birth (Lahdenperä et al., 2004).

However, the grandmother should also not be too young. If grandmothers are very young and still reproductive themselves, they put their energy in the care of their own offspring and have less possibilities to take care of their grandchildren. Sear et al. (2000) for example found evidence that young children in rural Gambia

are taller in the presence of non-reproductive grandmothers than grandmothers who are still reproductively active and Hawkes et al. (1997) report that non-reproductive Hadza grandmothers put much more effort in the acquisition of food than reproductive women/grandmothers do.

Hence, regarding the relationship between the age of the grandmother and her importance as a positive resource for her grandchildren I would hypothesize a nonlinear (parabolic) relationship, with her contribution to be highest in the middle age range (no young children of her own and not yet too old to contribute). This *parabolic age effect hypothesis* will be tested by looking at nonlinear effects of grandmother's age in the analysis.

Resource related factors at the level of the household are income, wealth, education and employment. The availability of these resources may influence the grandmother effect in several ways. Children of poor families are less enrolled in school, are more involved in child labor, and suffer from many other negative outcomes, including high levels of child mortality, disease and stunting (Basu and Tzannatos, 2003; Bourdillon, 2006; Duncan and Brooks-Gunn, 1997; Hope, 2005; Webbink et al., 2012). Educational enrolment is lower, because for many poor households the direct and indirect costs of schooling are a heavy economic burden (Admassie, 2003; Ananga, 2011). Grandmothers can compensate the opportunity costs of schooling of their grandchildren, who are not able to contribute to the household. They can enable parents to work outside the home or prevent children, especially girls, from taking over household tasks when their mother is working or missing (Smits & Huisman, 2013).

Regarding parental education and father's occupation, there is broad evidence that children from better educated parents and whose fathers have a non-farm job go to school and stay in school more often (Buchmann & Brakewood, 2000; Colclough et al., 2000; Ersado, 2005; Mingat, 2006; Smits & Gündüz-Hoşgör, 2006). Better educated parents (have) experience(d) the benefits of education themselves and therefore are expected to weigh off the costs and benefits more in favour of schooling than parents with little education (Huisman & Smits, 2009; Piotrowski & Paat, 2012). Also fathers with a non-fam job are expected -- and have been found (Breen & Goldthorpe, 1997; Huisman & Smits, 2015) -- to attach more value to schooling than those who work in the agricultural sector. Under such favourable circumstances, the presence of a grandmother might make less of a difference.
The presence of a grandmother is expected to be particularly important if parents are dead or missing in the household. Parental death and especially maternal death is known to have a negative impact on children's well-being and schooling outcomes (e.g. Case and Ardington, 2006; Evans and Miguel, 2007; Nyamukapa and Gregson, 2005). Single parenthood is also associated with negative effects on children's schooling (Martin, 2012; Pong & Ju, 2000; Potter, 2010). It seems likely

that under these circumstances, co-residence of the grandmother may be particularly beneficial to children's well-being and schooling. Research by Parker and Short (2009) in Lesotho confirms this for an African country.

Important resources in the local context are the educational and transport infrastructure, which both may influence the possibility of children to go to school. In SSA, the availability of (good quality) schools and infrastructure varies considerably according to the overall level of urbanization and development of the region. In more modern and urban areas, infrastructure is generally better and state influence stronger, which means that educational laws may be better enforced. The effects of globalization may also be stronger and value patterns that stress the importance of education and equality among sexes more commonly spread. This might put more pressure on parents to send their children to school (Huisman & Smits, 2009; Tansel, 2002). Smits and Gündüz-Hoşgör (2006) found for Turkey that children living in urban areas have significantly higher schooling attainments, and Fafchamps & Wahba (2006) found for Nepal that children living near towns and cities are more likely to attend school. Hence, the expectation is that particularly in rural areas a co-residing grandmother might increase young children's chances to go to school.

Gender-related factors

Most of the studies examining the relationship between the presence of a grandmother and the well-being of grandchildren report different outcomes for boys and girls (e.g. Borgerhoff Mulder, 2007; Gibson and Mace, 2005; Jamison et al., 2002; Strassmann, 2011). Hence gender-related factors should be included in the analysis as well.

In most regions of SSA, women are traditionally responsible for the day-to-day care of children and to a large extent for their economic support (Caldwell & Caldwell, 1987; Kandiyoti, 1988). There is evidence that a stronger position of women is associated with higher children's education, health and well-being (e.g. Hobcraft, 1993; Mukherjee and Das, 2008). Given that in regions where the position of women is stronger the position of grandmothers also tends to be stronger, the expectation is that in such regions the presence of a grandmother is particularly beneficial.

Besides the general position of women, the presence and extent of polygamy might be important too. Strassmann (2011: p.1) observed that in polygamous families, child mortality and stunting rates are significantly higher. She attributed this to the fact that polygamy creates conflicts within families associated with asymmetries in genetic relatedness. If there is more uncertainty about genetic relatedness among family members, the risk of conflict increases. Omariba & Boyle (2007) found that children from polygamous families are more likely to die

compared to those from monogamous families. Kandiyoti (1988: p.277) argues that in case of polygamy the continuing obligations of both men and women to their own kin do not foster a notion of the family or household as a corporate entity. To what extent this is also true for grandmothers living in these families is not clear. Hence, whether the effect on schooling of the presence of a grandmother in such families is stronger or weaker than in a monogamous family remains an empirical question to be answered in the analyses.

Other factors

Other factors that may affect the grandmother co-residence effect are the number of children and the birth order of a child. Regarding the number of children, literature indicates that the probability of going to school is smaller for children with more siblings (Booth & Kee, 2009; Huisman & Smits, 2009). A likely explanation is that children with more brothers and sisters have to share the available resources. With regard to birth order there is evidence that older children, in particular older girls, have lower schooling rates, probably because they have to work in the household or earn money to supplement household income (Buchmann & Hannum, 2001; Emerson and Souza, 2008; Webbink et al., 2013). In both cases, it seems likely that the presence of a grandmother may help to overcome these negative situations. I therefore expect the presence of a grandmother in the household to be more important in high fertility situations and for elder daughters.

3.4 Data and methods

Data

For this study, combined datasets from the African Demographic and Health Surveys (DHS) have been used. DHS are large, nationally representative household surveys. For each survey, non-overlapping area units (often enumeration areas) are randomly selected. These areas (called 'clusters' henceforth) are usually communities, villages, or city quarters. In the selected clusters, all households are listed and a random sample of 25-30 households is selected for the interviews. The DHS consists of a household survey, in which basic information is collected of all household members, and separate women's and men's surveys. In the women's surveys, all usual resident women aged 15 to 49 are invited for an oral interview. In this interview, information is obtained on socioeconomic, demographic, and health related issues.

To get a maximum discriminatory power, the data of all available DHS surveys for SSA countries held since 2000 have been pooled. For South Africa and Togo data for 1998 are used, as at the start of the project no other DHS surveys for

these countries were available. To control for the fact that the surveys are held in different years and that for most countries several surveys were brought together, an indicator for survey year is included in the analysis.

The combined dataset contains information derived from 69 surveys on 917.788 children (467.528 boys and 450.260 girls) aged 7–15 living in 29.925 local communities (sample clusters) within 1164 sub-national regions (called 'districts' henceforth) of 33 SSA countries. Because of missing cases on the variables parental education, (grand)parental age, polygamy, number of brothers and sisters, wealth and educational participation, and some unrealistic cases for (grand)parental age, in total 19.782 (2,2%) children have been removed from the dataset. Unrealistic cases are parents with an age below 19 or grandmothers aged below 31 (as the included children are at least 7 years old). The analysis therefore covers 898.006 children (457.286 boys and 440.720 girls). Structural missings on characteristics of parents and grandmothers who were absent from the household (e.g. education or occupation of a death father) are addressed using the dummy variable adjustment procedure, which leads to unbiased estimates of these variables (Allison, 2001; Little and Rubin, 2002).

Method and Variables

The dataset is characterized by a hierarchical structure. Households are nested within sample clusters, nested within districts, nested within countries. I use three-level logistic regression analysis to address the nesting of the households within sample clusters and districts, and include fixed effects dummies at the national level, to control for the nesting within countries. This strategy allows us to fully control for clustering and confounding at the national level, while retaining the possibility to study the role of context factors at the district and cluster level.

The dependent variable "educational participation" is a dummy variable indicating whether (1) or not (0) children aged 7–15 were attending school at the time of the interview. The upper age limit of 15 is chosen because above that age less children are living with their parents (e.g. because of early marriage, education, or parental death). The lower age limit is set at 7, because in most SSA countries a substantial number of children start schooling at a later than compulsory age (Huisman and Smits, 2009). The models are estimated with MLwiN, using second-order penalized quasi-likelihood (PQL2), the recommended estimating technique for multilevel logistic regression analysis (Goldstein and Rasbash, 1996).

The major independent variable is a dummy variable indicating whether (1) or not (0) children are living with a grandmother. Children co-resident with their grandmother are identified in the DHS-data by using the household roster, which

defines for all household members the relationship to the household head. Children are identified as living with a grandmother if (1) they are grandchildren of a female household head; (2) they are grandchildren of a male household head whose wife is also living in the household; (3) they are children of the household head, and the mother or mother in law of the household head is also living in the household; (4) they are children of a brother or sister of the household head, and the mother of the household head is also living in the household. All other children living in the household, including adopted and foster children, are considered as not living with their grandmother. Given the restricted information on the relationships within the households, it cannot be completely precluded that some of these children still live together with a grandmother, for example if they belong to the categories "Other family members" or "Not related household members". However, given that the number of school-aged children in the data who belong to these categories is very small (3%), the number of them living with a grandmother is expected to be negligible.

In situation (2) the grandmother might not in all cases be the biological grandmother of the child, because of polygamy. For polygamous households, there is not enough information available to determine which of the household head's wives is the 'real' grandmother. To control for this situation, a dummy variable has been added to the models, indicating whether (1) or not (0) the household is a polygamous household (the head has more than one wife). To find out whether this situation influenced the grandmother effect, the presence of an interaction of this variable with the grandmother dummy has been tested. This interaction was not significant.

Other independent variables are age of the grandmother, measured in years, and resource- and gender-related factors at household and context level. The presence of each parent is measured with two dummies, one indicating whether (1) or not (0) the parent is absent from the household and one indicating whether (1) or not (0) the parent is dead. Age of the child and age of its (grand)mother are interval variables. The variables 'number of sisters' and 'number of brothers' are interval variables ranging from 0 to 10 or more. Birth order is an interval variable ranging from 0 to 18 or more.

The models contain a number of control factors that are known or can be expected to influence children's educational participation. Household wealth, father's occupation, parental education and employment of the mother are factors that have been known to influence children's educational participation (Evangelista de Carvalho Filho, 2012; Glewwe & Jacoby, 2004; Mingat, 2007; Shavit & Blossfeld, 1993; Smits & Gündüz-Hoşgör, 2006).

Because income is lacking in the DHS data, household wealth was measured by the International Wealth Index (IWI; Smits and Steendijk, 2015), a comparative

asset-based wealth index. IWI indicates to what extent the household owns a basic set of assets, valued highly by people across the globe, such as TV's, cars, telephones and housing characteristics like the quality of the floor material and toilet facility. Education of the mother and father is measured in years of education completed. Occupation of the father is measured by three dummy variables, indicating whether (1) or not (0) the father was employed in a farm, lower non-farm (sales, services, manual), or upper non-farm (professional, technical, managerial, clerical) occupation. Employment of the mother is measured by a dummy variable indicating whether (1) or not (2) the mother aside from her housework did any other work last week. The questions used in the DHS surveys for measuring women's employment are: "Aside from your own housework, have you done any work in the last seven days?" And if the answer was no: "As you know, some women take up jobs for which they are paid in cash or kind. Others sell things, have a small business or work on the family farm or in the family business. In the last seven days, have you done any of these things or any other work? Women who answered yes on one of these questions are considered as being employed.

To indicate the relative position of the mother in the household I follow earlier research (Blanc & Wolff, 2001; Luz & Agadjanian, 2015; Spierings et al., 2010) and use the age difference between parents (age mother minus age father). This variable was recoded into three dummy variables with a respective age-difference of up to -6, -6 to 0, and 0 and more, thus indicating a step by step improvement of the relative position of the mother.

To study the importance of context factors, socio-economic characteristics (level of development, urbanization, education) and gender related cultural characteristics (age difference between spouses, polygamy) of the region have been added to the models. Level of development is indicated by the mean of the International Wealth Index in the region. Given that this index at the national level is highly correlated with the Human Development Index and with GNP per capita (Smits and Steendijk, 2015), it is expected to be a good development indicator at the sub-national level as well. Urbanization is measured by a dummy variable indicating whether (1) or not (0) the household is living in a rural area. Education is measured by the mean years of education of people aged 20-40 in the area. The relative position of women of the context in which the household lives, is indicated by the average age difference between parents as an interval variable and by the percentage of polygamous households in the area. Polygamous households are households where the male household head has more than one wife.

Given that for African countries hardly any indicator is available at the sub national level, context factors are created by aggregating household level variables to the sample cluster and district level. Sample clusters are villages or neigh-

bourhoods and therefore reflect the nearby community in which the household lives very well. Using context variables at the cluster level therefore seems preferable over using such variables at the more distant district level. However, the sample clusters in the data are rather small (at most 30 households and often much less). This means that there is little variation at that level and measurement is imprecise. At the district level, sample sizes are much larger. There is also evidence that context effects can be caught rather well by more distant variables (Smits et al., 2005), although education at cluster level forms an exception. Kravdal (2006) found that the context level of education works well at cluster level. Therefore context education was included at cluster level and the other context factors at district level.

To find out whether and in which ways the effect of a co-residing grandmother differs across circumstances, interactions between the grandmother dummy and a selected set of other variables at household and context level are tested. These other variables include the gender of the (grand)child, presence of its mother and father, socio-economic and gender factors at household and context level, and the time variable. In this interaction analysis, centred versions of the involved variables are used, so that the main effects can be interpreted as average effects.

3.5 Results

Table 3.1 provides descriptive statistics of the children in the sample. It shows that 16% of the children aged 7-15 is living with at least one grandmother and almost 73% is attending school at the time of interview. The average age of grandmothers in the sample was nearly 63 years. For 35% of the children the father is absent or dead and for 23% of the children the mother is absent or dead. Almost 71% of the population is living in a rural area.

Table 3.2 shows the results of the multilevel logistic regression analyses. Regarding the educational participation of the children, the models perform in line with what is already known (e.g. Huisman & Smits, 2009; 2015). Children are more often in school when their parents are more highly educated, the father is a 'non-farm' worker, the mother is employed, the household is wealthier, there are fewer siblings in the household, there is a more traditional situation with regard to the age difference between the parents (father older than mother) and the mother is not absent or dead. They are also more often in school when they live in an urban area, in an area with a higher educational level and in an area characterized by a stronger position of women (as indicated by the age difference between spouses). Children are less in school when they are living in a polygamous

Table 3.1 Descriptive statistics: Percentages, means of characteristics of children aged 7-15

Variables	%, mean	Min	Max	SD
School attendance (dependent variable)	72.9%	0	1	0.44
Household factors				
Grandmother in household	16.2%	0	1	0.37
Age grandmother	62.9	31	98	4.37
Sex is girl	49.1%	0	1	0.50
Age child	10.7	7	15	2.54
Age mother	38.0	19	98	7.39
Age father	46.9	19	98	8.80
Birth order	3.30	1	18	1.94
Number of Sisters	1.92	0	10	1.65
Number of Brothers	2.04	0	10	1.74
Mother alive, not in household	19.0%	0	1	0.39
Father alive, not in household	25.9%	0	1	0.44
Mother dead	4.4%	0	1	0.20
Father dead	9.6%	0	1	0.29
Household wealth (IWI)	27.0	0	100	22.73
Education father (years)	4.13	0	16	3.79
Education mother (years)	2.99	0	16	3.47
Mother employed	69.3%	0	1	0.46
Occupation Father:				
Farm (reference category)	60.4%	0	1	0.49
Lower non-farm	29.5%	0	1	0.46
Upper non-farm	10.1%	0	1	0.30
Relative position mother (age mother-age father):				
Father ≥6 years older than mother (reference category)	64.8%	0	1	0.37
Father 6-0 years older than mother	31.8%	0	1	0.36
Father younger than mother	3.3%	0	1	0.14
Polygamous household	12.9%	0	1	0.33
Context factors				
Living in rural area	70.7%	0	1	0.46
Level of development (district)	27.02	0.99	88.96	16.93
Relative position women (district)	-8.99	-27.1	0.04	2.64
Educational level (years, cluster)	2.9	0	12.5	1.30
Polygamy (district)	29.0%	0	1	0.19

Source: DHS (1998-2013)

environment. District level of development has a negative sign, which is unexpected. This is probably due to some multicollinearity with household level of development, as both are based on the same wealth index. Indeed, when household level wealth is removed from the models, the coefficient of district level of development becomes positive. This multicollinearity is not problematic for the outcomes regarding the grandmother effect, as it is between two control factors in the models (P. D. Allison, 2012; Voss, 2004). Removing either or both wealth-based variables from the models does not affect these outcomes at all. Given that the models performs well in all other respects, I accept it as a good models for studying the effect of grandmothers co-residence on children's schooling.

The grandmother effect

Model 1 shows that the co-residence of a grandmother is positively associated with the educational participation of grandchildren. This effect is significant and substantial. When controlling for other major risk factors at household and context level, the odds of being in school are about 42% higher for children living with a grandmother (see table 3.2). This finding is in line with the broadly held view that the presence of a grandmother is beneficial for her grandchild(ren). Another observation is that the strength of the grandmother effect depends non-linearly on her age. If the grandmother is young or old, the effect is weaker than if she is in her middle age. The shape of the relationship is displayed in Figure 3.2, which presents the odds ratios of the combined effect of the linear and quadratic coefficients of grandmother's age. The grandmother effect is the strongest for grandmothers in their late sixties and for young or very old grandmothers it is weaker. Children living with a grandmother aged 69 have a 28% higher odds of being in school than children with a grandmother of 40 years of age. The findings are in line with the idea that young grandmothers may be less of a resource as they are reproductive themselves and that (very) old grandmothers may be more of a burden than a resource for the household. They also suggest that African grandmothers in their 60s and 70s are not too old to provide a substantial contribution to the household.

Table 3.2 Multilevel logistic regression analyses of the educational participation of children aged 7-15 in 33 SSA countries: log odds, standard errors and odds ratios†

	Model 1		Model 2	
	β (S.E.)	Exp(β)	β (S.E.)	Exp(β)
Fixed part				
Intercept	1.10***(0.207)		1.07***(0.205)	
Grandmother (Gm) in household	.349***(0.017)	1.42	.372***(0.018)	1.45
Age grandmother	.034***(0.007)	1.04	.036***(0.007)	1.04
Age grandmother square	-.0002***(0.000)	1.00	-.0002***(0.00)	1.00
Household factors				
Age child	.027***(0.006)	1.03	.028***(0.006)	1.03
Sex is girl	-.250***(0.020)	0.78	-.248***(0.020)	0.78
Age mother	.037***(0.004)	1.04	.035***(0.004)	1.04
Birth order child	-.024***(0.002)	0.98	-.025***(0.002)	0.97
Number of sisters	.007***(0.003)	1.01	.008***(0.003)	1.01
Number of brothers	-.027***(0.002)	0.97	-.025***(0.002)	0.97
Mother alive, not in household	-.150***(0.055)	0.86	-.159***(0.055)	0.85
Father alive, not in household	-.324** (0.166)	0.72	-.319** (0.165)	0.73
Mother dead	-.226***(0.056)	0.80	-.208***(0.055)	0.81
Father dead	-.349***(0.166)	0.71	-.342***(0.165)	0.71
Household wealth (IWI)	.026***(0.001)	1.03	.027***(0.001)	1.03
Education father (years)	.080***(0.002)	1.08	.079***(0.002)	1.08
Education mother (years)	.085***(0.002)	1.09	.086***(0.002)	1.09
Mother employed	.145***(0.014)	1.16	.144***(0.014)	1.16
Occupation father (ref=farm)				
- Lower non-farm	.113***(0.023)	1.12	.097***(0.024)	1.10
- Upper non-farm	.212***(0.047)	1.24	.209***(0.047)	1.23
Position mother (ref=father >6 yrs older)				
- Father 0-6 years older than mother	-.004 (0.011)	1.00	-.002 (0.011)	1.00
- Father younger than mother	-.128***(0.026)	0.88	-.147***(0.028)	0.86
Polygamous household	-.124***(0.014)	0.88	-.130***(0.014)	0.88
Context factors				
Living in rural area	-.528***(0.080)	0.59	-.504***(0.081)	0.60
Level of development (district)	-.014***(0.002)	0.99	-.012***(0.002)	0.99
Educational level (cluster)	.149***(0.013)	1.16	.151***(0.013)	1.16
Position women (district)	.028 (0.020)	1.03	.026 (0.021)	1.03
Polygamy (district)	-1 .65***(0.302)	0.19	-1.73***(0.304)	0.18
Year	.047***(0.007)	1.05	.049***(0.007)	1.05

Table 3.2 Continued

	Model 1		Model 2	
	β (S.E.)	Exp(β)	β (S.E.)	Exp(β)
Interactions with grandmother dummy				
Gm * Sex is girl			.116***(0.020)	1.12
Gm * Mother alive, not in household			.156***(0.017)	1.17
Gm * Mother dead			.065***(0.024)	1.07
Gm * Number of sisters			-.002***(0.006)	0.98
Gm * Occupation father (lower non-farm)			-.159***(0.071)	0.85
Gm * Educational level (cluster)			.039***(0.010)	1.04
Gm * Level of development (district)			.007***(0.001)	1.01
Gm * Father younger than mother			-.271***(0.106)	0.76
Gm * Living in rural area			.191***(0.043)	1.19
Random part				
District level (3)				
- Variance intercept schooling	.430***(0.026)		.433***(0.026)	
- Random effect covariance Gm	.061***(0.010)		.044***(0.010)	
- Random effect variance Gm	.049***(0.006)		.029***(0.005)	
Cluster level (2)				
- Variance intercept schooling	.776***(0.031)		.777***(0.031)	
- Random effect covariance Gm	-.074***(0.011)		-.076***(0.011)	
- Random effect variance Gm	.432***(0.020)		.428***(0.020)	

***P<0.01 **P<0.05
(n=898.006 of which 145.444 living with a grandmother and 655.783 is attending school)
† Both models include the full set of country-level fixed effects dummies to control for confounding and clustering at the national level

The role of the context

The random effect variances and covariances related to the co-residence of a grandmother are presented at the bottom of Table 3.2. These (co)variances are highly significant and sizable. Hence, the grandmother effect varies substantially across districts and clusters and it makes sense to study cross-level interactions between grandmother's co-residence and the district and cluster level variables.

The results of the interaction analysis are presented in Model 2 of Table 3.2. There are a substantial number of significant interactions between the grandmother co-residence effect and variables at household, cluster and district level. A first important interaction is with the gender of the grandchild: co-residence of a grandmother is significantly more important for girls than for boys. For girls,

the odds of being in school increases by 54 percent in households with a co-residing grandmother, whereas for boys this increase is 37 percent.

Presence of a grandmother is particularly important if the mother is dead or missing in the household. In those situations, the presence of a grandmother increases the odds of being in school by 7 to 17% respectively. Interestingly, in case of a dead or missing father, presence of a grandmother does not make a significant difference for children's schooling. Hence it seems that grandmothers may replace a missing mother, but less so a missing father. The negative coefficient of the interaction with the number of sisters might indicate that children's schooling is hindered by household tasks that are either performed by the grandmother or by co-residing (probably older) sisters.

When the father is employed in a lower non-farm job, the grandmother effect is significantly lower than when he is a farmer. Hence, grandmothers are more important in farm households than among non-farm manual workers. For upper non-farm workers such a difference is not present. Of the other interactions with household level factors tested, none is found significant.

Besides with household characteristics, there are significant interactions with characteristics of the context in which the household is situated. With regard to socio-economic characteristics of the context, both education (at cluster level) and level of development (at district level) show positive and significant interactions with the grandmother variable. This seems to indicate that presence of a grandmother is more favourable for children's schooling in situations where schooling opportunities are already rather good. In districts where the age difference between spouses is smaller, the presence of a grandmother is less important. This might be due to the stronger position of the mother, who therefore is less in need of support of a grandmother. No significant interaction effect of living in a polygamous household was found, which indicates that the effect on children's schooling of a co-residing grandmother does not significantly differ from children not living in polygamous households.

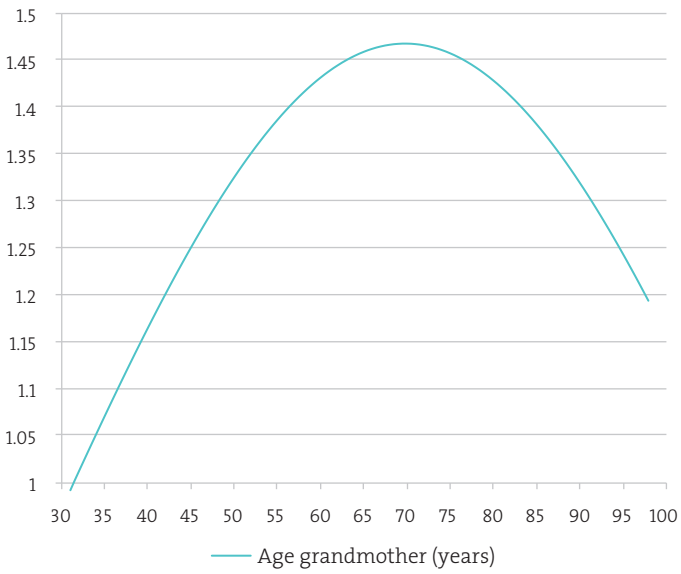
Grandmothers are more important if the household lives in a rural area. In those areas, the odds of being in school are increased by 19% for children with a co-residing grandmother. This is in line with the finding discussed above, that grandmothers are more important in farm households than in households where the father works in a lower nonfarm occupation. An explanation might be found in the fact that most of these grandmothers grew up in rural areas. Those who are still living there probably have more possibilities to contribute to the household than those who moved to the city, where they can make themselves less useful and may more easily become a burden to the household. No significant interaction between the grandmother effect and year of survey was found, indicating that the importance of a co-residing grandmother is more or less stable over time.

3.6 Conclusion and discussion

On the basis of data on almost 900.000 children aged 7–15, living in 33 SSA countries, broad evidence is found that living with a grandmother is positively associated with the chances of young children to be in school. Although the interaction analysis shows that certain conditions weaken the grandmother effect, no indications of negative grandmother effects were found. Hence I am led to the conclusion that, at least for the educational participation of children, the presence of a grandmother in the household is a positive resource under a broad range of circumstances within the SSA context. This result is in line with most earlier research (Hawkes et al., 1997; Hrdy, 1999; Sear et al., 2000; Sear & Mace, 2008).

Children living in a household with a co-residing grandmother on average have 45% higher odds of being in school than children living without a co-residing grandmother. Age of the grandmother is also important for children's schooling and shows an inverse-U shape relationship with children's schooling (see Figure 3.2).

Figure 3.2 Relationship between age of co-residing grandmother and odds of being in school*



* Figure based on the grandmother's age and age² variables from model 2 (table 3.2)

The contribution of a grandmother is highest for grandmothers who are in their sixties or seventies and lower for grandmothers who are younger or older. This is not surprising, as young grandmothers may still have children at home and very old granny's often need care themselves and become net consumers. Girls profit more from a co-residing grandmother than boys, which indicates that grandmothers take over household tasks that otherwise would have been done by girls.

The interaction analysis shows that the grandmother effect is not everywhere the same, but varies according to specific resource- and gender-related factors at the household and context level. The effect is especially strong when the mother is dead or missing in the household, but it is hardly affected by the absence or death of the father. Hence grandmothers may replace a missing mother, but less so a missing father. Interestingly, a co-residing grandmother is particularly good for children's schooling when the household is situated in a more developed (wealthier) environment or in a community with a more highly educated population. It thus seems that grandmothers help the family to make better use of favourable circumstances. This finding is in line with the local resource competition hypothesis, which predicts altruistic behaviour of family members to be reduced when there is scarcity of local resources (and thus enhanced under more favourable circumstances).

There are no significant interactions with wealth or education at the household level and with the work status of the mother. Hence, poor and uneducated households profit as much from a co-residing grandmother as wealthier and educated households. Although one would expect the grandmother to be more important when the mother has a job, the effect is not influenced by the work status of the mother. Occupation of the father on the other hand does make a difference. Grandmothers are more important when the father is employed in a farm job instead of a lower non-farm job. A possible explanation may be that most of the grandmothers in the data grew up in rural areas, often at farms. This means that they are probably more familiar with life in the countryside -- and can contribute more to the household there -- than in an urban environment. This explanation is further supported by the finding that grandmothers are less effective when the household is located in an urban environment.

No significant interaction is found with the age of the children, which indicates that grandmothers are equally important for children at the primary and the lower secondary school level. In households where the position of the mother is stronger, measured by the age difference with her husband, and in households with more (grand) daughters, a co-residing grandmother makes less of a difference. If mothers have a stronger bargaining power, or if household tasks can be divided among more daughters, there might be less need for a grandmother

to contribute to the household. Given the negative effects of polygamy on child survival documented in earlier research (e.g. Omariba & Boyle, 2007; Strassmann, 2011), the question was raised whether the grandmother effect on children's schooling would be affected by polygamy, at the household or at the community level. This turned out not to be the case. The contribution of a grandmother in these households, thus seems to be of a general nature that benefits all children in the household to more or less the same extent.

In sum, I found evidence in favour of the existence of a positive grandmother effect on children's schooling across a broad range of circumstances in the SSA context. Compared to earlier research this study is a major step forward, as it provides -- for the first time -- a broad comparative analysis of the role played by context factors for the relationship between grandmothers co-residence and child well-being, in particular children's schooling. The findings make clear that grandmothers should not be overlooked when designing policies aimed at strengthening the position of women and children in the SSA context.

However, some caution is required regarding the conclusions, as this study has some limitations. First, it is based on cross-sectional data. This implies that although important new information is obtained on the association between grandmothers' co-residence and children's schooling and on the variation of this relationship across circumstances, no strict conclusions in terms of causal relations can be drawn. Second, as the data does not contain information on non-residing grandmothers, it was not possible to say something about the distance gradient in grandmother support. Grandmothers who live in the vicinity of their (grand)children are probably better able to support them than grandmothers who live further away. Insight into the nature of this relationship is essential for policy makers and social agents who want to strengthen existing family ties in order to improve the position of children. Further research is therefore needed on this distance gradient, as well as on some other missing factors, like the role played by local organizations, like schools, governmental services and NGO's. Finally, because earlier studies found differences in children's well-being depending on whether they were living with a paternal or maternal grandmother (Borgerhoff Mulder, 2007; Sear, 2008; Strassmann, 2011) the effect may vary according to the lineage of the grandmother. The next chapter delves deeper into the relationship between the lineage of the grandmother and children´s schooling.

Chapter 4

Paternity Uncertainty or Male Dominance? Paternal versus Maternal Grandmothers' Contribution to Children's Schooling in sub-Saharan Africa [4]

4 This chapter was presented at the RC28-conference held at Tilburg University, Netherlands May 2015.

Abstract

The *confidence of paternity hypothesis* predicts grandparental investment to depend on the likelihood of genetic relatedness with a (grand) child. Because paternity uncertainty is larger for their son's children, grandmothers are expected to invest more in their daughter's children. However, most African cultures are characterized by male dominance, making it more profitable to invest in sons than in daughters. I study the relative importance of paternal versus maternal grandmothers for children's schooling and how this grandmother gender effect varies across circumstances.

The effect of grandmothers' gender on children's schooling is studied using multi- level logistic regression analysis on almost 900.000 children aged 7–15 living in 33 SSA countries. The analysis is controlled for demographic and socio-economic factors at the household and context level. The role of circumstances is studied by the use of interaction analysis.

Children living with a paternal grandmother have a higher chance of being in school than children living with a maternal grandmother. This difference is larger for boys, when the father is more highly educated and when there is a grandfather in the household. It is reduced when mother's educational level is higher.

I found no support for the confidence of paternity hypothesis. Children living with a paternal grandmother have better schooling outcomes relative to those living with a maternal grandmother. The advantage of living with a paternal grandmother is stronger for boys. Male dominance as a cultural factor seems to be more important for grandmother's investments than certainty about genetic relatedness. More education helps to draw grandmothers' investments towards one's children.

4.1 Introduction

In chapter 3 broad evidence was found in favour of the existence of a positive grandmother effect with respect to children's schooling across a wide range of circumstances in the sub-Saharan African (SSA) context. The extent to which this effect depends on the lineage of the grandmother is studied in this chapter.

Evolutionary theory has often been used to explain grandparental investment in general and more specific the investment differences between maternal and paternal grandmothers (e.g. Bishop et al., 2009; Euler & Michalski, 2007; Laham et al., 2005). The classic grandmother hypothesis supposes the prolonged survival of women after their fertile ages to have developed during human evolution, because it offers them the possibility to increase their own reproductive success by helping their daughters raising their children (Hamilton, 1964; Hawkes et al., 1997; Hawkes, 2004). Additionally, evolutionary theory predicts grandmothers to invest more in their daughters' children than in their son's children. This expectation is based on what is called the *confidence of paternity hypothesis* (Gaulin & Schlegel, 1980; Strassmann & Garrard, 2011). The idea behind this hypothesis is that grandparental investment depends on the likelihood of being genetically related to a certain grandchild. The uncertainty about genetic relatedness is smaller for maternal grandmothers than for paternal grandmothers. Mother's mother knows for certain that her daughter is her daughter and that her daughter's child is her grandchild. Father's mother is certain that her son is her son, but is less certain that her son's child is her grandchild, because the wife of her son may be unfaithful. The confidence of paternity hypothesis therefore predicts maternal grandmothers to be more willing to invest in their grandchildren than paternal grandmothers.

Although this argument seems reasonable, empirical evidence does not unequivocally support it. Some studies analysing the effect of grandmothers on child well-being show indeed stronger effects of the presence of maternal grandmothers (Sear et al., 2000; Voland & Beise, 2002). In rural Gambia for example maternal grandmothers doubled the survival chances of a Mandinka child (Sear et al., 2000). In Ethiopia maternal grandmothers had a positive effect on child survival by relieving their daughters of heavy domestic work. (Gibson & Mace, 2005). However, other researchers found no differences (Beise, 2005; Gibson & Mace, 2005), or even a more positive effect of the presence of paternal grandmothers (Borgerhoff Mulder, 2007; Sear, 2008). This might mean that other factors play a role as well. The most likely factor is the influence of local culture in which the household is living. Culture might be important because many African communities are characterized by a culture of male dominance, in which men are considered more important than women. (Giovarelli et al., 2013; Jütting et al.,

2008; Kandiyoti, 1988). This preference given to sons over daughters appears for instance in the ownership of land, poor inheritance rights of women and difficulties women experience in filing claims through the judicial system (Cooper, 2012; International African Institute, 1950; Richardson, 2004; Unicef, 2007). The social dominance of males over females – and the social prestige associated with having sons – might make it more socially rewarding for grandmothers to invest in the offspring of her son(s) than her daughters, even though the genetic relatedness is less certain. Hence, according to the *male dominance hypothesis,* grandmothers are more inclined to invest in her sons' children than her daughters' children.

Additionally, a factor that potentially may be important is the role of socio-economic circumstances; it might make a difference whether the household is wealthy or poor. The *local resource competition hypothesis* (e.g. Borgerhoff Mulder, 2007; Sear & Mace, 2008) emphasizes the negative effects on altruistic behaviour of family members due to scarcity of local resources. Strassmann (2011) found that under poor circumstances (Dogon in Mali) co-residence of a paternal grandmother was associated with a higher hazard of death of a grandchild by the age of five. One of the explanations given is that elderly grandmothers (mostly the paternal grandmother) are net-consumers and therefore become competitors for their grandchildren in the resource-poor society of the Dogon. Borgerhoff Mulder (2007) observed, using within-population variation in land ownership in Kenya, that wealth affects the extent of kin altruism. Paternal relatives (specifically father's brothers) appear to buffer young children from mortality much more effectively in rich than in poor households. However, in case of resource conflicts paternal grandmothers seem to improve child survival. To what extent there is a positive grandmother effect on children's schooling might thus depend on the circumstances, with the effect being weaker when the grandmother is old or the household is living under poor circumstances.

Another interesting perspective on the role of resources is the *Trivers-Willard hypothesis* (Hopcraft, 2005; Trivers & Willard, 1973; Trivers, 1972) which supposes grandparents to invest more in their sons under good socio-economic circumstances and in their daughters under poor circumstances. The explanation for this is that women prefer high status men over low status men when it comes to reproduction. Whereas men in this respect are more indifferent in their choice. Under poor circumstances, men are therefore a riskier option to invest in when it comes to reproduction. The chance that they will end up without a wife and do not produce offspring is higher than it is for women. For women, the chances to marry are better under poor circumstances, as men are less concerned about the status of their wife. Under poor circumstances, it might for example be more attractive for a woman to become the second or third wife of a wealthy husband

than to be the first wife of a poor husband. Investing in daughters and their families might therefore be the best evolutionary strategy for (grand)parents in poor households, whereas investing in sons would be the best strategy for (grand) parents in wealthy households.

The current study aims to test these hypotheses by comparing the effects of co-residence of paternal versus maternal grandmothers on the educational participation of their grandchildren. Using a newly built database with information on grandparental co-residence for 917.778 children in 33 SSA countries, I test to what extent and in what way the effect of co-residing grandmothers on the educational participation of their grandchildren differs between paternal and maternal grandmothers. Moreover, I examine whether and in what way this effect differs under varying circumstances.

This study improves on earlier research in important ways. First, by conducting broad comparative research covering all SSA regions, which -- in comparison to the earlier small scale local studies -- offers the opportunity to draw more general conclusions. Second, by focusing on children's schooling as outcome variable. Most research in the field until now has focused on health-related outcomes. Focusing on education is important, as education is essential for building up human capital, increasing employment chances and stimulating economic growth (Lutz et al., 2008; UNESCO, 2014). Grandparents interested in the well-being of their grandchildren can therefore be expected to use their resources to facilitate their grandchildren's schooling. Third, by including context factors at the household, community and district level, I control more effectively for confounding factors than in earlier research that only controls for household-level factors. Fourth, by including interactions in the model to gain insight into how the difference between paternal and maternal grandmothers varies across contexts and whereby obtaining situation-specific insights.

4.2 Data and Methods

In studying the relative importance of the paternal versus the maternal grandmother the same database as in chapter 3 was used. It contains information on 917.788 children (467.528 boys and 450.260 girls) aged 7–15 living in 29.925 local communities (sample clusters) within 1164 sub-national regions (called 'districts' henceforth) of 33 SSA countries. Because of missing cases on the variables parental education, (grand)parental age, polygamy, number of brothers and sisters, wealth and educational participation, and some unrealistic cases for (grand)parental age, in total 20.099 (2,2%) cases have been removed from the dataset. Unrealistic cases are parents with an age below 19 or grandmothers aged below 31 (as the included

children are at least 7 years old). The analysis therefore covers 897.689 children. Structural missings on characteristics of parents and grandmothers who were absent from the household (e.g. education or occupation of a death father) are addressed using the dummy variable adjustment procedure, which leads to unbiased estimates of these variables (Allison, 2001; Little and Rubin, 2002). The data is supplemented with context information at the level of districts and clusters. Giving the large sample size of the database, district and cluster variables could be created by aggregating data at household level.

The relative importance of paternal versus maternal grandmothers and the effect on schooling is studied using multilevel logistic regression analysis. I use three-level logistic regression analysis to address the nesting of the households within sample clusters and districts, and include fixed effects dummies at the national level, to control for the nesting within countries. This strategy allows us to fully control for clustering and confounding at the national level, while retaining the possibility to study the role of context factors at the district and cluster level. Multilevel regression analysis is the appropriate method to analyse such clustered data (Khan & Shaw, 2011). In the model the dependent variable comprises educational participation, which is a dummy variable indicating whether (1) or not (0) children aged 7–15 were attending school at the time of the interview. The upper age limit of 15 was chosen because above that age already a substantial number of children is not living with their parents anymore (e.g. because of early marriage, for educational reasons, or parental death). The lower age limit was set at 7 to avoid excluding children in countries where many children start schooling later than the compulsory age (Huisman & Smits, 2009). Because the dependent variable is dichotomous, it violates the assumption of a normal distribution of errors and of homoscedasticity for OLS regression (P. Allison, 1999; Pampel, 2000). I therefore apply *logistic* regression models. The models are estimated with MLwiN, using second-order penalized quasi-likelihood (PQL2), the recommended estimating technique for multilevel logistic regression analysis (Goldstein & Rasbash, 1996). Descriptive statistics of the variables are presented in Table 4.1.

The major independent variable is a categorical variable that measures whether the children were living in a household with only a maternal grandmother, only a paternal grandmother, a maternal and a paternal grandmother, or no grandmother. This variable is entered into the analyses as a set of dummy variables. Households where one or both parent(s) of a male household head or of a male partner of the household head are living are considered patrilocal. Households where one or both parent(s) of a female household head or of a female partner of the household head are living are considered matrilocal. If parents of

Table 4.1 Descriptive statistics: Percentages, means of characteristics children aged 7-15

Variables	%, mean	min	max	sd
School attendance	72.9%	0	1	0.44
Demographic factors at household level				
Maternal grandmother co-resident	3.3%	0	1	0.18
Paternal grandmother co-resident	4.6%	0	1	0.21
Grandmother co-resident (both parents absent)	8.3%	0	1	0.28
No grandmother co-resident	83.8%	0	1	0.37
Age grandmother	62.9	31	98	4.37
Grandfather co-resident	6.8%	0	1	0.25
Age child	10.7	7	15	2.54
Sex is girl	49.1%	0	1	0.50
Age mother	38.0	19	98	7.39
Age father	46.9	19	98	8.80
Birth order child	3.3	1	18	1.94
Number of sisters	1.9	0	10	1.65
Number of brothers	2.0	0	10	1.74
Mother alive, not in household	19.0%	0	1	0.39
Mother dead	4.4%	0	1	0.20
Father alive, not in household	25.9%	0	1	0.44
Father dead	9.6%	0	1	0.29
Socio-economic factors at household level				
International Wealth Index (IWI)	27.0	0	100	22.7
Education father (years)	4.13	0	16	3.79
Education mother (years)	2.99	0	16	3.47
Education grandmother (years)	1.48	0	16	1.14
Occupation father (ref.=farm):	60.4%	0	1	0.33
Lower non-farm	29.5%	0	1	0.24
Upper non-farm	10.1%	0	1	0.14
Mother employed	69.3%	0	1	0.46
Position mother (age mother – age father)	-9.39	-73	60	7.79
Polygamous household	12.9%	0	1	0.33
Socio-economic/Cultural factors at context level				
Living in rural area	70.7%	0	1	0.46
International Wealth Index (district)	27.02	0.99	88.9	17.0
Position mother (age mother – age father, district)	-8.99	-27.14	0.04	2.64
Educational level (cluster)	2.93	0	12.5	1.30
Polygamy (district)	29.0%	0	1	0.19

Source: DHS (1998-2013)

both sides are present, the household is considered of mixed locality. Given the aim to study the difference between households with only a maternal grandmother and households with only a paternal grandmother, the focus of the analyses is on the dummy variable that represents this difference. In the remainder of this chapter, this variable will be called the *grandmother gender effect*. When studying the size of this effect, the focus will be on the more or less 'normal' situation where at least one of the parents is living in the household. The more extreme situation that children live with a grandmother because of absence or death of both parents is left out of this comparison, because the data do not allow to distinguish between paternal and maternal grandmothers in this situation. To control for this setting in the analyses, an extra dummy was added to the model to indicate the households where a grandmother is present, but where both parents are absent. The lower age limit for grandmothers was set at 31 years.

To find out whether the grandmother gender effect differs according to the situation in which the household lives, interactions between the grandmother gender effect and the other independent variables in the model are studied. In this interaction analysis centred versions of these independent variables were used. The coefficients of the grandmother gender effect in the interaction model are thus for an average situation for the other variables. Given the explorative nature of the interaction analysis and the potentially large number of interactions, only significant interactions are included in the model.

Control factors

Next to the main independent variable, several other variables were added to the analyses as control factors. The presence of each parent is measured with two dummies, one indicating whether (1) or not (0) the parent is absent from the household and one indicating whether (1) or not (0) the parent is dead. Birth order, age of the child, age of its mother and grandmother, and the number of brothers and sisters were measured by interval variables. The presence of a grandfather is measured by a dummy variable.

Household wealth was measured by the International Wealth Index (IWI; Smits and Steendijk, 2015), a comparative asset-based wealth index. IWI indicates to what extent households own a basic set of assets, valued highly by people across the globe. Education of the mother, father and grandmother is measured in years of education completed. Occupation of the father is measured by three dummy variables: (1) Farm, (2) Lower non-farm (sales, services, manual), (3) Upper non-farm (professional, technical, managerial, clerical). Work status of the mother is a dummy variable indicating whether (1) or not (0) the mother was employed.

To control for the relative position of women at both household and context level, the age difference between husbands and wives was used. This age difference was measured as age mother minus age father. For the relative position of women in the context where the household lives, the average of the age difference between parents in the district as an interval variable was used. The larger the age difference to the disadvantage of the women in the area, the weaker their position is considered to be. Of the other context factors urbanization was measured by a dummy variable indicating whether (1) or not (0) the child lived in a rural area. The context level of development was measured as the mean International Wealth Index score of households in the district. Context education was measured by aggregating the variable years of education to the level of the DHS sample cluster. The context variable polygamy is calculated as the percentage of polygamous households in the district.

Children with a missing parent or grandparent were given the mean score of the other children on the (grand)parents characteristics. Because dummy variables indicating whether (1) or not (0) the (grand)parent is missing are included, this procedure leads to unbiased estimates of these variables (P. D. Allison, 2001).

4.3 Results

The results of two three-level logistic regression models are presented in Table 4.2 (Full model output in Appendix 4.1 at the end of this chapter). Model 1 contains only main effects. Model 2 contains main effects plus all significant interaction effects. The analysis focuses particularly on the *grandmother gender effect*, which is measured by the difference in educational participation between children in households with (only) a paternal grandmother and children in households with (only) a maternal grandmother (the reference category). The significant positive coefficient indicates that children in households with (only) a paternal grandmother have higher odds of being in school. Hence the effect is opposite to the prediction of the confidence of paternity hypothesis; grandmothers seem to support the children of their sons more than those of their daughters. Compared to grandchildren living with a maternal grandmother, the odds of being in school are on average 19% higher for grandchildren living with their paternal grandmothers (Model 1).

The second aim of this study is to shed light on how the strength of the grandmother gender effect is moderated by varying circumstances. To test this, interactions between the grandmother gender effect and all other household and context variables were estimated. Significant interactions were found with sex of

the child, father's and mother's education and the presence of a grandfather in the household. Model 2 includes all significant interactions. The results indicate that the grandmother gender effect is significantly stronger for boys than for girls. Hence the advantage of living with a paternal instead of a maternal grandmother is larger for boys than for girls. This difference is about 15% to the advantage of boys (exp(β)=1.15).

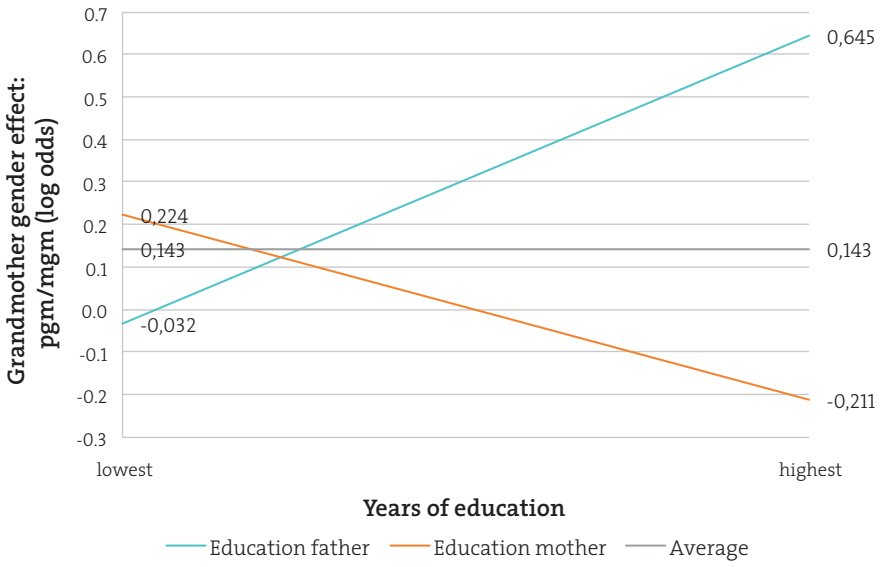
Table 4.2 Coefficients of multilevel logistic regression models and the log odds of being in school as dependent variable (odds ratios between brackets)

	Model 1	**Model 2**
Grandmother gender effect (ref=maternal grandmother)	β (exp (β))	β (exp (β))
Grandmother gender effect average	**.170*** (1.19)**	**.143*** (1.15)**
Grandmother gender effect girls		**.071 (1.07)**
Grandmother gender effect boys		**.212*** (1.24)**
Interactions with grandmother gender effect		
Grandmother gender effect * Boys		.141*** (1.15)
Grandmother gender effect * Education mother		-.003** (0.97)
Grandmother gender effect * Education father		.042*** (1.04)
Grandmother gender effect * Grandfather co-resident		.165*** (1.18)

***P<0.01, **P<0.05, *P<0.1. The following variables were added to the analysis as control factors at household level: age child, age mother and grandmother, birth order, number of sisters and brothers, mother and father missing, wealth, education father, mother and grandmother, occupation father, employment mother, age difference parents, grandfather co-resident, maternal and paternal grandmother co-resident, grandmother co-resident (but both parents absent), no grandmother co-resident. At context level: living in a rural area, wealth, age difference parents, level of education, polygamy.

Parental education is known to be an important factor in relation to children's schooling (Huisman & Smits, 2009). The interaction analysis makes clear that also parental education is significantly associated with the grandmother gender effect. Interestingly, the grandmother gender effect is negatively related to maternal education and positively to paternal education. This implies that the advantage children have when living with a paternal grandmother becomes larger if their fathers are more highly educated. At the same time, this advantage is smaller when their mothers are more highly educated. The strength of these effects is almost similar. In both cases, an increase of parental education by one year is associated with a change of the grandmother gender effect of about 3-4%. In figure 4.1, these interaction effects are depicted graphically.

Figure 4.1 Grandmother gender effect and level of education parents



The figure shows that when father has no education, the grandmother gender effect is close to zero. Indicating that there is no difference in effect on children's schooling between paternal and maternal grandmothers. As the educational level of the father increases, this has a positive impact on the grandmother gender effect: The higher the father's education, the more important the paternal grandmother is for children's schooling. A higher educational level of the mother on the other hand, pushes the grandmother gender effect into the opposite direction. It decreases towards zero and for highly educated mothers may become even negative, indicating a more positive role for maternal grandmothers compared to paternal grandmothers with respect to children's schooling.

The last significant interaction effect is with the presence of a grandfather in the household. Given that there are very few cases in the data where both a paternal grandmother and a maternal grandfather or a maternal grandmother and a paternal grandfather are living in the same household (only 0.098% of households with a grandmother), the co-resident grandfather is in almost all cases the husband of the grandmother. The presence of a grandfather significantly strengthens the grandmother gender effect, thus indicating that the combination of a paternal grandmother with the paternal grandfather is particularly favourable for children's schooling.

4.4 Conclusion and discussion

According to the classical grandmother hypothesis the prolonged survival of women after their fertile ages has developed during human evolution because it offers them the possibility to increase their own reproductive success by helping their daughters raising their children (Hamilton, 1964; Hawkes et al., 1997; Hawkes, 2004). The expectation that they would invest more in their daughters' children than in their sons' children is based on the so called *confidence of paternity hypothesis*. Grandparental investment is supposed to depend on the likelihood of being genetically related to a certain grandchild, which is more certain for maternal than for paternal grandmothers. On the basis of a database with information on grandparental co-residence for 897.689 children in 33 SSA countries, I have tested this hypothesis by studying the extent to which the effect of co-residing grandmothers on the educational participation of their grandchildren differs between paternal and maternal grandmothers.

The analyses did not provide any support for the confidence of paternity hypothesis. In fact the opposite effect was observed. Children living with their paternal grandmother have better schooling outcomes relative to those who are living with their maternal grandmother. This means that I have to reject the confidence of paternity hypothesis in favour of alternative hypotheses. The most likely of these alternative hypotheses is called here the *male dominance hypothesis*. This hypothesis predicts the effect of a co-residing grandmother on the schooling of her grandchildren to be more positive for her son's children than for her daughter's children. As discussed in the introduction, many regions of Africa are characterized by a culture of male dominance in which men, sons and grandsons are considered more important than women, daughters and granddaughters (Giovarelli et al., 2013; Jütting et al., 2008; Kandiyoti, 1988). The finding that the presence of a paternal grandmother is more favourable for children's schooling than the presence of a maternal grandmother provides support for this hypothesis. It seems that the preference for sons over daughters in these cultures is so strong that grandmothers tend to favour their son's children over their daughters children even though the genetic relatedness of their son's children is less certain. The importance of male dominance is further supported by the finding that the grandmother gender effect is particularly strong for boys. This implies that grandmothers not only invest more in their son's children than in their daughters children, but also that they invest more in their son's sons than in their son's daughters. The interaction analysis further revealed the grandmother gender effect to depend on the educational level of the parents. Interaction effects with father's and mother's education have about the same strength, but work in opposite directions. Father's education strengthens the grandmother gender

effect and mother's education weakens this effect. This means that the tendency of grandmothers to invest in the children of their sons or their daughters is also influenced by the resources in the form of human capital those sons and daughters have at their disposal. If their sons have more human capital their investments go more into the direction of their sons children and if their daughters have more human capital they invest relatively more in their daughters children.

No significant interaction was found between the grandmother gender effect and household wealth. This suggests that the effect does not depend on the financial resources of the household. Hence neither the *resource competition hypothesis* nor the *Trivers Willard hypothesis* are supported by the results.
Finally, the interaction analysis revealed that the presence of a grandfather more or less doubles the grandmother gender effect. Given that in almost all cases the grandfather is the husband of the grandmother, this indicates that grandfathers have an equally strong tendency as grandmothers to invest more in the children of their sons than in the children of their daughters. In the next chapter I will delve deeper into relation between grandfathers and the schooling outcomes of their grandchildren.

Appendix 4.1 β-coefficients of multilevel logistic regression models with the log odds of being in school as dependent variable (odds ratios between brackets)

	Model 1		Model 2	
*Grandmother effect for **girls** (ref=maternal grandmother)*	B (exp (B))		B (exp (B))	
Paternal grandmother present	.170***	(1.19)	.071	(1.07)
Undefined grandmother present	.462***	(1.59)	.429***	(1.54)
No grandmother present	-.008***	(0.92)	-.019***	(0.83)
*Grandmother effect for **boys** (ref=maternal grandmother)*				
Paternal grandmother present	.170***	(1.19)	.212***	(1.24)
Undefined grandmother present	.462***	(1.59)	.515***	(1.67)
No grandmother present	-.008***	(0.92)	.169	(1.02)
Demographic and socio-economic factors at household level				
Age child	.029***	(1.03)	.029***	(1.03)
Age mother	.035***	(1.04)	.035***	(1.04)
Age mother square	-.000***	(1.00)	-.000***	(1.00)
Age grandmother	.049***	(1.05)	.046***	(1.05)
Age grandmother square	-.000***	(1.00)	-.000***	(1.00)
Birth order child	-.024***	(0.98)	-.024***	(0.98)
Number of sisters	.009***	(1.01)	.009***	(1.01)
Number of brothers	-.025***	(0.98)	-.025***	(0.98)
Mother alive, not in household	-.571***	(0.57)	-.570***	(0.57)
Mother dead	-.642***	(0.53)	-.640***	(0.53)
Father alive, not in household	-.322**	(0.72)	-.320**	(0.73)
Father dead	-.348**	(0.71)	-.346**	(0.71)
Grandfather present	-.056***	(0.95)	.077***	(1.08)
International Wealth Index (IWI)	.027***	(1.03)	.027***	(1.03)
Education father (years)	.079***	(1.08)	.075***	(1.08)
Education mother (years)	.087***	(1.09)	.087***	(1.09)
Education grandmother (years)	.080***	(1.08)	.079***	(1.08)
Occupation father, lower non-farm *(ref=farm)*	.115***	(1.12)	.115***	(1.12)
Occupation father, upper non-farm *(ref=farm)*	.221***	(1.25)	.221***	(1.25)
Mother employed	.142***	(1.15)	.142***	(1.15)
Relative position women (age mother – age father)	.004***	(1.00)	.004***	(1.00)
Socio-economic factors at context level				
Living in rural area	-.522***	(0.59)	-.522***	(0.59)
International Wealth Index (district)	-.014***	(0.99)	-.014***	(0.99)
Age difference (district)	.024	(1.02)	.024	(1.02)
Educational level (cluster)	.148***	(1.16)	.148***	(1.16)
Polygamy (district)	1.794***	(0.17)	1.791***	(0.17)

Appendix 4.1 Continued

	Model 1	Model 2
Interactions with grandmother present	B (exp (B))	B (exp (B))
Paternal grandmother * Sex is girl		-.141*** (0.87)
Paternal grandmother * Education mother		-.027** (0.97)
Paternal grandmother * Education father		.042*** (1.04)
Paternal grandmother * Grandfather present		.165*** (1.18)

***P<0.01, **P<0.05, *P<0.1. (n=897.689)

Chapter 5

(When) are grandfathers beneficial for children's schooling in sub-Saharan Africa? [5]

5 This chapter was presented at the RC28-conference at the National University of Singapore, Singapore May 2016.

Abstract

According to the classical grandmother hypothesis, the presence of a grandmother is important for the survival of her grandchildren. About the role of grandfathers, theory is less clear. Grandfathers are usually associated with more distant and authoritarian ways of involvement. However, also their reproductive success is increased by the survival of their grandchildren.

To gain more insight into the importance of grandfathers in the sub-Saharan African context, the relationship between grandfather's co-residence and children's schooling on the basis of data for 900.000 children aged 7–15 in 33 African countries is studied in this chapter.

While controlling for risk factors at household and community level, I find that children living with their grandfather have significantly higher odds of being in school than children who are not living with their grandfather. This effect increases with grandfather's age and is particularly strong for older children and for girls. This study is the first to document a positive relationship between the presence of a grandfather and the schooling of children in the sub-Saharan African context.

5.1 Introduction

The results in the previous two chapters have shown a positive association between grandmother's presence and the schooling outcomes of their grandchildren. Children seem to benefit in particular from the co-residence of a paternal grandmother. But what about grandfathers? Theory regarding the role of grandmothers and child survival often refers to the classical grandmother hypothesis. This hypothesis assumes that the prolonged survival of women after their fertile ages has developed during human evolution, because it offers women the possibility to increase their own reproductive success by helping their children to raise their children (Hamilton, 1964; Hawkes et al., 1997; Hawkes, 2004). Is there such a thing as a grandfather's version of the classical grandmother hypothesis? Although the reproductive success of grandfathers is also increased by the survival of their grandchildren, they get less attention in the literature. There are a few historical studies reporting both positive and negative associations between the presence of a grandfather and child survival in Poland, Canada, Germany and Italy (Beise, 2005; Derosas, 2002; Kemkes-Grottenthaler, 2005; Tymicki, 2009). Some more recent studies examining the association between grandfathers and child survival in Africa found hardly any association (Borgerhoff Mulder, 2007; Gibson & Mace, 2005; Sear et al., 2000; Sear, 2008). This does not necessarily mean that African grandfathers are not important at all for their grandchildren, but it suggests that for identifying grandparental effects it might be important to look at other outcomes than child survival and/or study these effects under specific circumstances.

It is for example possible that grandfathers become important when parents are missing or when there is no grandmother who can help their (grand)children. It is also possible that grandfathers become of greater importance when children are older. While (grand)mothers are supposed to be focused on feeding and caring of young children, (grand)fathers might be more focused on the societal position of their grandchildren. It might for example be possible that the social status and masculinity of African grandfathers to a certain extent depends on the educational achievements of their grandchildren.

Given the substantial number of sub-Saharan African (SSA) children living in households with grandparents and the increasing importance of education for employment chances and economic growth on this continent (Lutz et al., 2008; UNESCO, 2014), gaining insight into the role grandfathers play for children's schooling has become increasingly important. This chapter aims to provide this insight. I determine the strength of the relationship between grandfather's co-residence and children's schooling and how this relationship is influenced by the circumstances in which the household is situated.

By applying multilevel logistic regression analysis on a database with information on almost 900.000 children aged 7-15, living in 33 countries, I aim to answer the following research questions:

- *What is the overall relationship between grandfather's co-residence and their grandchildren's educational participation?*
- *To what extent do socio-economic, demographic and cultural characteristics at the household and context level influence this relationship?*

A major step forward of this approach is that I study the influence of context factors on the grandfather effect at the level of 1164 sub-national regions -- and at the level of 29.925 communities – within 33 countries. This means that I have considerable power to study effects of context factors in a multivariate way and can answer questions about the role of the context better than in earlier studies.

In the next section, I first discuss the importance of education and the reasons why grandfathers in SSA may be living with their (grand)children. Then a theoretical framework is presented and hypotheses are formulated. Section 5.4 describes the data and methods that will be used. In section 5.5 the results are presented. Concluding remarks are given in section 5.6.

5.2 Background

Grandfathers and schooling

Schooling can be seen as an activity that influences future benefits through the imbedding of resources, human capital, in people. Next to physical capital, human capital is crucial for economic development as well as for children's prospects in life (Becker, 1962). Although much research has already been done on the determinants of children's schooling in poor countries (Glick & Sahn, 2006; Huisman & Smits, 2015; Lloyd & Blanc, 1996; Mukherjee & Das, 2008; Smits & Huisman, 2013) the role of the grandfather for children's schooling has received little attention in the literature. Only a few studies provide some statistical evidence regarding this relationship. For example, Parker and Short (2009) found no effect of living with a grandfather and children's schooling in Lesotho and Zeng and Xie (2014) showed for rural China that the educational level of co-resident grandparents is positively associated with the educational attainment of their grandchildren.

There is also research comparing grandparent-headed households and households headed by other relatives regarding schooling outcomes. Children of grandparent-headed households in Malawi, Mozambique and Zambia have better educational outcomes than those living in households headed by other relatives, such as an aunt or niece (e.g. Ainsworth et al., 2005; Case et al., 2004; Nyamukapa

and Gregson, 2005). Other studies investigate the difference in school attendance between orphans and non-orphans (e.g. Bicego et al., 2003; Nyambedha et al., 2003; Nyamukapa & Gregson, 2005), but in these studies grandparents play a minor role. Broad comparative research that can teach us how the relationship between grandfather's co-residence and children's schooling varies across circumstances is lacking for Africa, as well as for other low-income contexts.

Why are grandfathers living with their (grand)children?

To increase the understanding of the role played by co-residence grandfathers with respect to the schooling of their grandchildren, a first important question to be answered is why do grandparents reside with their (grand)children? In the African context, the reasons for this are diverse. In some regions and among some groups the cultural tradition exists that one or more children remain living with their parents after marriage (e.g. Kandiyoti, 1988; Fox, 1967; Korotayev, 2003). The partners of these children then come to live in the family home and become a member of the extended family system. Under poor circumstances, sharing costs of living in this way increases survival chances and care needs can be fulfilled more easily. Living together with their children also constitutes a natural old-age security system for the (grand)parents (Laferrère and Wolff, 2006). Over time, the situation may gradually change from one in which the grandparents are the major driving forces of the household to one in which the next generation takes over. The grandparents then become the helping hands, as long as their health allows this.

Another way in which (grand)parents and children may come to live together is when children after marriage establish their household elsewhere, but the grandparents move in later. This might for example be for financial reasons, or because the grandparents need care or one of them has died. Depending on the health status of the (grand)parents, they may then be a resource or a burden for the household.

Still another possibility is that children come to live with their grandparents because their parents are dead or ill. When parents die, grandparents are usually the ones that take over the care for their grandchildren. In SSA, where overall mortality levels are high and an estimated 15 million children have lost one or both of their parent(s), this is a very common situation (UNAIDS, 2013). Depending on the circumstances, the child may move to the household of the grandparent(s) or the grandparent(s) may come to live in the parental home.

5.3 Theoretical framework

Generative grandfathering or resource competition?

Women may live long after their reproductive period; a phenomenon which is not very common in nature. In most species breeding is possible throughout adult life. Regardless of the actual evolutionary origin of this phenomenon, it offers women (grandmothers) the possibility to increase their reproductive success by helping their daughters and sons raising their children (Hamilton, 1964; Hawkes et al., 1997; Hawkes, 2004). But what about men? Men are able to reproduce until their death, which enables them to enhance their inclusive fitness throughout their lives. Does this mean that they are not involved in taking care of their grandchildren?

Theory concerning the relationship between grandfathers and grandchildren in developing countries is scarce. Intuitively, given the supposed strong bond between mothers and daughters, grandmothers are expected to help their daughters with the care for their children (Coall & Hertwig, 2010; Hawkes, 2003, 2004; Sear & Mace, 2008). Particularly in developing countries, where extended household structures are still pervasive, grandmothers are supposed to play a role of importance in this respect. Regarding grandfathers this is different. Grandfathers are usually associated with more distant and authoritarian ways of involvement (Bates & Taylor, 2012; Mann et al., 2015) and have therefore got much less theoretical attention in the child survival and health literature, so I cannot draw extensively from the literature in this field. That is why theoretical ideas are derived from studies in other fields, in particular the gerontological literature on grandparenthood in developed countries like the US and UK (e.g. Bates & Taylor, 2012; Creasey & Koblewski, 1991; Mann et al., 2015).

A useful framework for studying and understanding the role of grandfathers has been built by Bates (2009). At the heart of his conceptual framework of *generative grandfathering* is the developmental stage of 'generativity', introduced by Erikson (1963) as one of the eight stages in psychosocial development. In the *generative* stage of life (ages 40-64), establishing and guiding the next generation forms a central theme. Grandfathering and generativity are connected by Bates through the generative work of grandfathers, which can be described as the efforts grandfathers put forth when nurturing and caring for their offspring. This involves lineage work, spiritual work, recreation work, family identity work, and investment work (Bates, 2009).

Some of these forms of generative work may have a direct effect on schooling such as 'mentoring work' or 'investment work'. *Mentoring work* concerns the efforts grandfathers put forth to teach, instruct and coach their grandchildren. In doing so, grandfathers also transfer a part of their own knowledge to their

grandchildren. This implies that the educational level of a grandfather might be important for schooling as well. *Investment work* concerns the ability and willingness of grandfathers to invest in the educational, occupational and financial needs of their grandchildren. Other forms of generative work like 'lineage work' and 'spiritual work' might help grandchildren to develop their own identity and to become a stable personality, which is also important for schooling. I hypothesize that the average effect of grandfather's co-residence through his generative work is positive for their grandchildren's schooling. This *positive grandfather hypothesis* is based on the expectation that grandfathers who are living with their grandchildren have a low threshold to invest in them. According to Bates & Taylor (2012) contact frequency and participating in activities are key elements of a positive grandfather role and co-residence grandfathers are in the best situation for having a high contact frequency and participate in activities with their grandchildren.

It seems obvious to assume that the degree and quality of generative work grandfathers put forth to their grandchildren varies and depends on the characteristics of the grandfather. Important characteristics of the grandfather that may play a role are his age and educational level. Higher educated grandfathers have experienced themselves the benefits of good education, which may make them better equipped to teach, instruct and coach their grandchildren. It might also make them more eager to teach their grandchildren and to stimulate them to go to school than grandfathers with no or less education.

When (grand)fathers get older, they become more experienced. Their image of leadership and masculinity shifts and they may become more emotionally expressive and affectionate towards their grandchildren. They may wish to teach about interpersonal relationships and to transfer values to their grandchildren (Fuller-Thomson & Minkler, 2001; Waldrop et al., 1999). Such a mentoring and teaching role might become a particularly rewarding experience for grandfathers, if the degree of success of their grandchildren contributes to the level of respect they gain from their social environment. However, at some point the grandfather may become too old to take care of his grandchildren, or even of himself, and he might become a drain for the household. Grandfathers should also not be too young. When grandfathers are very young, they are busy with their own work and have to put their energy in caring for their own offspring and have less possibilities to take care of their grandchildren. The relationship between grandfathers' age and the role they may play for their grandchildren is thus expected to be parabolic, with their contribution being more important at an intermediate age than when they are very young or old. A similar relationship is expected for grandmother's age. Hence, regarding the relationship between the age of grandparents and their importance as a positive resource for grandchildren

I would hypothesize a nonlinear (parabolic) relationship, with their contribution to be highest in the middle age range (less other dominant responsibilities and not yet too old to contribute). This *parabolic age effect hypothesis* will be tested by looking at nonlinear effects of grandparent's age in the analysis.

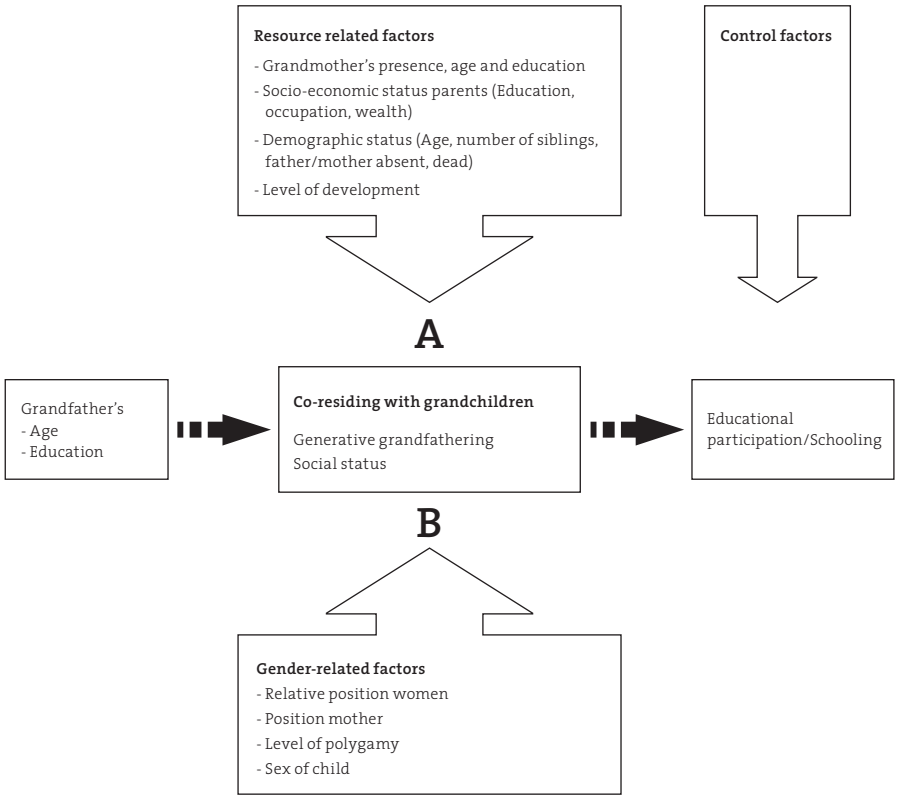
Grandfathers and child survival

Empirical research on grandfathers and children's schooling in Africa is very limited. Parker & Short (2009) are an exception and tested this relationship for Lesotho and found no significant effect of a co-residence grandfather. Other research has been focussing on child survival as outcome variable instead of schooling. A meta-analysis conducted by Sear & Mace (2008) gives a broad overview of the empirical work in this field. Their analysis shows that grandfathers in 4 out of 20 studies were positively associated with child survival, in 3 studies negatively and in 13 studies there was no significant effect at all. For grandmothers these figures were 16 positively, 3 negatively and 7 no effect out of 26 studies respectively. The results indicate that grandfathers are less important than grandmothers when it comes to child survival. Most of the studies included in the analysis concerned pre-modern European, Asian, North and South American countries. In the few African studies available (4) there were no significant connections reported between grandfather's presence and child survival (Borgerhoff Mulder, 2007; Gibson & Mace, 2005; Sear et al., 2000; Sear, 2008).

The role of the circumstances

Because of the variation in grandfather effects found in previous research, the main focus of the current paper is on the role of the circumstances. Factors reflecting these circumstances are expected to moderate the grandfather co-residence effect and are divided into two groups: resource- and gender-related factors, represented in Figure 5.1 by the arrows A and B. The strength of the grandfather effect is expected to vary according to the availability of these factors at household and context level (research question 2). For example on whether or not the parents and other household members are present and on specific characteristics of the household like household wealth, work status of the mother, occupation of the father and the presence of siblings. Factors related to the context in which the household is situated are for example the district level of development and polygamy, but also the cluster level of education. In the next section, these factors and other control variables are discussed.

Figure 5.1 Conceptual model of relationship between grandfathers' co-residence and children's schooling in SSA



Resource related factors

Resource related factors at the level of the household are income, wealth, education and employment of the parents. The availability of these resources may influence the grandfather effect in several respects. Children of poor families are less enrolled in school, are more involved in child labor, and suffer from many other negative outcomes, including high levels of child mortality, disease and stunting (Basu and Tzannatos, 2003; Bourdillon, 2006; Duncan and Brooks-Gunn, 1997; Hope, 2005; Webbink et al., 2012). Their educational enrolment is lower, because the direct and indirect costs of schooling may be a heavy economic burden to their parents (Admassie, 2003; Ananga, 2011). Grandfathers can compensate the opportunity costs of schooling of their grandchildren. They can enable parents to

work outside the home or prevent children, from taking over work when their mother or father is working or missing (Smits & Huisman, 2013).

Regarding parental education and father's occupation, there is broad evidence that children from better educated parents and whose fathers have a non-farm job go to school and stay in school more often (Buchmann & Brakewood, 2000; Colclough et al., 2000; Ersado, 2005; Mingat, 2006; Smits & Gündüz-Hoşgör, 2006). Better educated parents (have) experience(d) the benefits of education themselves and therefore are expected to weigh off the costs and benefits more in favour of schooling than parents with little education (Huisman & Smits, 2009; Piotrowski & Paat, 2012). Also fathers with a non-fam job are expected -- and have been found (Breen & Goldthorpe, 1997; Huisman & Smits, 2015) -- to attach more value to schooling than those who work in the agricultural sector. Under such more favourable circumstances, presence of a grandfather might make less of a difference.

Grandparents might also be a burden to the household resources. The *local resource competition hypothesis* (e.g. Borgerhoff Mulder, 2007; Sear and Mace, 2008) predicts that altruistic behaviour of family members may be reduced when there is scarcity of local resources. Several studies support this hypothesis. Strassmann (2011) found the co-residence of a grandmother among the Dogon in Mali to be negatively related to child survival and growth. She attributes this to the fact that older grandmothers become net-consumers and therefore competitors for their grandchildren in the resource-poor society of the Dogon. This might also be applicable to grandfathers. Sear (2008) discovered that among the Chewa in Malawi child mortality rates are higher in the presence of matrilineal kin. She supposed this negative effect to be caused by resource competition between kin. Borgerhoff Mulder (2007) observed while studying land ownership in Kenya that wealth affects the extent of kin altruism. Paternal relatives (specifically father's brothers) appear to buffer young children from mortality much more effectively in rich than in poor households. To what extent there is a positive grandfather effect on children's schooling might thus depend on the circumstances, with the effect being weaker when the grandfather is old and/or when the household is living under poor circumstances.

The presence of a grandfather is expected to be particularly important if parents are dead or missing in the household. Parental death is known to have a negative impact on children's well-being and schooling outcomes (e.g. Case and Ardington, 2006; Evans and Miguel, 2007; Nyamukapa and Gregson, 2005). Single parenthood is also associated with negative effects on children's schooling (Martin, 2012; Pong & Ju, 2000; Potter, 2010). It seems likely that under these circumstances, co-residence of the grandfather may be particularly beneficial to children's well-being and schooling.

Important resources at the local context are the educational and transport infrastructure, which both may influence the possibility of children to go to school. In SSA, the availability of (good quality) schools and infrastructure varies considerably according to the overall level of urbanization and development of the region. In more modern and urban areas, infrastructure is generally better and state influence stronger, which means that educational laws may be better enforced. The effects of globalization may also be stronger and value patterns that stress the importance of education and equality among sexes more commonly spread. This might put more pressure on parents to send their children to school (Huisman & Smits, 2009; Tansel, 2002). Smits and Gündüz-Hoşgör (2006) found for Turkey that children living in urban areas have significantly higher schooling attainments, and Fafchamps & Wahba (2006) found for Nepal that children living near towns and cities are more likely to attend school. Hence, the expectation is that particularly in rural areas a co-residing grandfather might increase young children's chances to go to school.

Gender-related factors

Most of the studies examining the relationship between the presence of grandparents and the well-being of grandchildren report different outcomes for boys and girls (e.g. Borgerhoff Mulder, 2007; Gibson and Mace, 2005; Jamison et al., 2002; Strassmann, 2011). Hence gender-related factors are included in the analysis as well. With respect to grandparents there is evidence that granddaughters tend to report closer contact with grandmothers and grandsons with grandfathers (Hagestad & Speicher, 1981; Mann & Leeson, 2013). In line with this empirical evidence boys are expected to benefit more from the co-residence of a grandfather than girls.

There is evidence that a stronger position of women is associated with higher children's education, health and well-being (e.g. Hobcraft, 1993; Mukherjee and Das, 2008). Given that in regions where the position of women is stronger the position of mothers and grandmothers also tends to be stronger. The expectation therefore is that in such regions the presence of a grandfather is less important.

Besides the position of women, the presence and extent of polygamy might be important too. Strassmann (2011: p.1) observed that in polygamous families, child mortality and stunting rates are significantly higher. She attributed this to the fact that polygamy creates conflicts within families associated with asymmetries in genetic relatedness. If there is more uncertainty about genetic relatedness among family members, the risk of conflict increases. Omariba & Boyle (2007) found that children from polygamous families are more likely to die compared to those from monogamous families. Kandiyoti (1988: p.277) argues that in case of polygamy the continuing obligations of both men and women to

their own kin do not foster a notion of the family or household as a corporate entity. To what extent this is also true for grandfathers living in these families is not clear. Hence, whether the effect on schooling of the presence of a grandfather in such families is stronger or weaker than in a monogamous family remains an empirical question to be answered in the analyses.

Other factors

Other factors that may affect the grandfather co-residence effect are the number of children in the household and the birth order of a child. Regarding the number of children, literature indicates that the probability of going to school is smaller for children with more siblings (Booth & Kee, 2009; Huisman & Smits, 2009). A likely explanation is that children with more brothers and sisters have to share the available resources. With regard to birth order there is evidence that older children, in particular older girls, have lower schooling rates, probably because they have to work in the household or earn money to supplement household income (Buchmann & Hannum, 2001; Emerson and Souza, 2008; Webbink et al., 2013). In both cases, the presence of a grandfather may provide additional resources to compensate for these situations. Therefore the presence of a grandfather in the household is expected to be more important in high fertility situations and for elder daughters.

5.4 Data and methods

Data

For this study, combined datasets from the Demographic and Health Surveys (DHS) have been used. DHS are large, nationally representative household surveys. For each survey, non-overlapping area units (often enumeration areas) are randomly selected. These areas (called 'clusters' henceforth) are usually communities, villages, or city quarters. In the selected clusters, all households are listed and a random sample of 25-30 households is selected for the interviews. The DHS consists of a household survey, in which basic information is collected of all household members, and separate women's and men's surveys. In the women's surveys, all usual resident women aged 15 to 49 are invited for an oral interview. In this interview, information is obtained on socioeconomic, demographic, and health related issues.

To get a maximum discriminatory power, the data of all available DHS surveys for SSA countries held since 2000 have been pooled. For South Africa and Togo data for 1998 are used, as at the start of the project no other DHS surveys for these countries were available. To control for the fact that the surveys are held in

different years and that for most countries several surveys were brought together, an indicator for survey year is included in the analysis.

In studying the role of the grandfather the same database as in chapters 3 and 4 was used. The combined dataset contains information derived from 69 surveys on 917.788 children (467.528 boys and 450.260 girls) aged 7–15 living in 29.925 local communities (sample clusters) within 597 sub-national regions (called 'districts' henceforth) of 33 SSA countries. Because of missing cases on the variables parental education, (grand)parental age, polygamy, number of brothers and sisters, wealth and educational participation, and some unrealistic cases for (grand)parental age, in total 19.782 (2,2%) children have been removed from the dataset. Unrealistic cases are parents with an age below 19 or grandparents aged below 31 (as the included children are at least 7 years old). The analysis therefore covers 898.006 children (457.286 boys and 440.720 girls). Structural missings on characteristics of parents and grandparents who were absent from the household (e.g. education or occupation of a death father) are addressed using the dummy variable adjustment procedure, which leads to unbiased estimates of these variables (Allison, 2001; Little and Rubin, 2002).

Method and Variables

The dataset is characterized by a hierarchical structure. Households are nested within sample clusters, nested within districts, nested within countries. I use three-level logistic regression analysis to address the nesting of the households within sample clusters and districts, and include fixed effects dummies at the national level, to control for the nesting within countries. This strategy allows to fully control for clustering and confounding at the national level, while retaining the possibility to study the role of context factors at the district and cluster level.

The dependent variable "educational participation" is a dummy variable indicating whether (1) or not (0) children aged 7–15 were attending school at the time of the interview. The upper age limit of 15 is chosen because above that age less children are living with their parents (e.g. because of early marriage, education, or parental death). The lower age limit is set at 7, because in most SSA countries a substantial number of children start schooling at a later than compulsory age (Huisman and Smits, 2009). The models are estimated with MLwiN, using second-order penalized quasi-likelihood (PQL2), the recommended estimating technique for multilevel logistic regression analysis (Goldstein and Rasbash, 1996).

The major independent variable is a dummy variable indicating whether (1) or not (0) children are living with a grandfather. Children living with their grandfather are identified in the DHS-data by using the household roster, which defines for all household members the relationship to the household head.

Children are identified as living with a grandfather if (1) they are grandchildren of a male household head; (2) they are grandchildren of a female household head whose husband is also living in the household; (3) they are children of the household head, and the father or father in law of the household head is also living in the household; (4) they are children of a brother or sister of the household head, and the father of the household head is also living in the household. All other children living in the household, including adopted and foster children, are considered as not living with their grandfather. Given the restricted information on the relationships within the households, it cannot be completely precluded that some of these children still live together with a grandfather, for example if they belong to the categories "Other family members" or "Not related household members". However, given that the number of school-aged children in the data who belong to these categories is very small (3%), the number of them living with a grandfather is expected to be negligible.

Other independent variables are age and educational level of the grandparents, measured in years, and resource- and gender-related factors at household and context level. The presence of each parent is measured with two dummies, one indicating whether (1) or not (0) the parent is missing in the household and one indicating whether (1) or not (0) the parent is dead. Age of the child and age of its (grand)parents are interval variables. The variables 'number of sisters' and 'number of brothers' are also interval variables ranging from 0 to '10 or more'. This is also the case concerning the values of 'birth order' which run from 0 to '18 or more'.

The models contain a number of control factors that are known or can be expected to influence children's educational participation. Household wealth, father's occupation, parental education and employment of the mother are factors that have been known to influence children's educational participation (Evangelista de Carvalho Filho, 2012; Glewwe & Jacoby, 2004; Mingat, 2007; Shavit & Blossfeld, 1993; Smits & Gündüz-Hoşgör, 2006).

Because income is lacking in the DHS data, household wealth was measured by the International Wealth Index (IWI; Smits and Steendijk, 2015), a comparative asset-based wealth index. IWI indicates to what extent the household owns a basic set of assets, valued highly by people across the globe, such as TV's, cars, telephones and housing characteristics like the quality of the floor material and toilet facility. Education of the parents is measured in years of education completed which ranges from 0 to 16 years. Occupation of the father is measured by three dummy variables, indicating whether (1) or not (0) the father was employed in a farm, lower non-farm (sales, services, manual), or upper non-farm (professional, technical, managerial, clerical) occupation. Employment of the mother is measured by a dummy variable indicating whether (1) or not (2) the mother aside

from her housework did any other work last week. The questions used in the DHS surveys for measuring women's employment are: "Aside from your own housework, have you done any work in the last seven days?" And if the answer was no: "As you know, some women take up jobs for which they are paid in cash or kind. Others sell things, have a small business or work on the family farm or in the family business. In the last seven days, have you done any of these things or any other work? Women who answered yes on one of these questions are considered as being employed.

To indicate the relative position of the mother in the household I follow earlier research (Blanc & Wolff, 2001; Luz & Agadjanian, 2015; Spierings et al., 2010) and use the age difference between parents (age mother minus age father). This variable was recoded into three dummy variables with a respective age-difference of up to -6, -6 to 0, and 0 and more, thus indicating a step by step strengthening of the relative position of the mother or in other words a weakening of the position of the father.

To study the importance of context factors, socio-economic characteristics (level of development, urbanization, education) and gender related cultural characteristics (age difference between spouses, polygamy) of the region have been added to the models. Level of development is indicated by the mean of the International Wealth Index in the region. Given that this index at the national level is highly correlated with the Human Development Index and with GNP per capita (Smits and Steendijk, 2015) it is expected to be a good development indicator at the sub-national level as well. Urbanization is measured by a dummy variable indicating whether (1) or not (0) the household is living in a rural area. Education is measured by the mean years of education of people aged 20-40 in the area. The relative position of women in the context where the household lives is indicated by the average age difference between parents as an interval variable and by the percentage of polygamous households in the area. Polygamous households are households where the male household head has more than one wife.

Given that for African countries hardly any indicator is available at the sub-national level, context factors are created by aggregating household level variables to the sample cluster and district level. Sample clusters are villages or neighbourhoods and therefore reflect the nearby community in which the household lives very well. Using context variables at the cluster level therefore seems preferable over using such variables at the more distant district level. However, the sample clusters in the data are rather small (at most 30 households and often much less). This means that there is little variation at that level and measurement is less precise. At the district level, sample sizes are much larger. There is evidence that context effects can be caught rather well by more distant variables (Smits et al., 2005), although education at cluster level forms an

exception. Kravdal (2006) found that the context level of education works well at cluster level. I therefore include context education at cluster level and the other context factors at district level.

To find out whether and in which ways the effect of a co-residing grandfather differs across circumstances, interactions between the grandfather dummy and all other variables at household and context level are tested. These other variables include the gender of the (grand)child, presence of its mother and father, socio-economic and gender factors at household and context level, and the time variable. In this interaction analysis, centred versions of the involved variables are used, so that the main effects can be interpreted as average effects. Only the significant results of the interaction analysis are reported.

5.5 Results

Descriptive statistics of the variables used in the models reveal that 6.8% of the children aged 7-15 in the sample is living with at least one grandfather and 16.2% is living with at least one grandmother (Table 5.1).

Almost 73% of the children is attending school at the time of interview. The average age of grandfathers in the sample is almost 68 years against nearly 63 years for grandmothers. There are more children living with a missing father than with a missing mother. In 23.4% of the cases the mother is absent or dead and for 35.5% of the children the father is absent or dead. Most of the children in the dataset are living in a rural area (71%). On average grandfathers have obtained more years of education (2.7 years) than grandmothers (1.5 years) and parents in general are better educated than grandparents.

The grandfather effect

Table 5.2 shows the β-coefficients, standard errors and log odds of the multilevel logistic regression model for the effect of grandfather's co-residence on the educational participation of children aged 7-15. The model includes grandfather's and grandmother's co-residence, characteristics of the grandparents, of the parents, of the household the child is living in and factors at cluster and district level like wealth, educational level and the relative position of women.

The co-residence of a grandfather is positively associated with the educational participation of his grandchild(ren). This effect is significant and substantial. When controlling for confounding factors at household and context level, the odds of being in school are about 16% higher for children living with a grandfather. This finding is in line with the *positive grandfather hypothesis* which predicts grandfather's co-residence to be beneficial to grandchildren's schooling.

Table 5.1 Descriptive statistics: Percentages, means of characteristics of children aged 7-15

Variables	%, mean	Min	Max	SD
School attendance (dependent variable)	72.9%	0	1	0.44
Household factors				
Grandfather in the household	6.8%	0	1	0.25
Age grandfather	67.7	31	98	2.74
Education grandfather (years)	2.7	0	16	1.02
Grandmother in household	16.2%	0	1	0.37
Age grandmother	62.9	31	98	4.37
Education grandmother (years)	1.48	0	16	1.14
Sex is girl	49.1%	0	1	0.50
Age child	10.7	7	15	2.54
Age mother	38.0	19	98	7.39
Age father	46.9	19	98	8.80
Birth order	3.30	1	18	1.94
Number of Sisters	1.92	0	10	1.65
Number of Brothers	2.04	0	10	1.74
Mother alive, not in household	19.0%	0	1	0.39
Father alive, not in household	25.9%	0	1	0.44
Mother dead	4.4%	0	1	0.20
Father dead	9.6%	0	1	0.29
Household wealth (IWI)	27.0	0	100	22.73
Education father (years)	4.13	0	16	3.79
Education mother (years)	2.99	0	16	3.47
Mother employed	69.3%	0	1	0.46
Occupation Father:				
Farm (reference category)	60.4%	0	1	0.33
Lower non-farm	29.5%	0	1	0.24
Upper non-farm	10.1%	0	1	0.14
Relative position mother (age mother-age father):				
Father ≥6 years older than mother (reference category)	64.8%	0	1	0.37
Father 6-0 years older than mother	31.8%	0	1	0.36
Father younger than mother	3.3%	0	1	0.14
Polygamous household	12.9%	0	1	0.33
Context factors				
Living in rural area	70.7%	0	1	0.46
Level of development (district)	27.22	0.99	88.96	16.93
Relative position women (district)	-8.99	-27.1	0.04	2.64
Educational level (years, cluster)	2.93	0	12.5	1.30
Polygamy (district)	29.0%	0	1	0.19

Source: DHS (1998-2013).

Table 5.2 β-coefficients, standard errors and odds ratios of grandfather's and grandmother's co-residence, control factors and the schooling of children aged 7-15 in 33 SSA countries as dependent variable†

	β-coefficient	S.E.	Exp(β)
Grandparental factors			
Intercept	1.29***	0.153	
Grandfather in household	.145***	0.040	1.16
Grandmother in household	.329***	0.017	1.39
Age grandfather	.003**	0.001	1.00
Age grandmother	.031***	0.009	1.03
Age grandmother square	-.0002***	0.000	1.00
Education grandfather (years)	.048***	0.006	1.05
Education grandmother (years)	.075***	0.006	1.08
Child factors			
Age child	.029***	0.001	1.03
Sex (0=boy; 1=girl)	-.247***	0.020	0.78
Birth order child	-.024***	0.003	0.98
Household factors			
Age mother	.042***	0.005	1.04
Age mother square	-.0004***	0.000	1.00
Age father	-.005***	0.000	1.00
Number of sisters	.008***	0.003	1.01
Number of brothers	-.026***	0.003	0.97
Mother alive, not in household	-.518***	0.166	0.60
Father alive, not in household	-.312*	0.170	0.73
Mother dead	-.581***	0.165	0.56
Father dead	-.347**	0.165	0.71
Household wealth (IWI)	.026***	0.001	1.03
Education father (years)	.079***	0.002	1.08
Education mother (years)	.087***	0.003	1.09
Mother employed	.143***	0.015	1.15
Occupation father (ref=farm)			
- Lower non-farm	.116***	0.024	1.12
- Upper non-farm	.224***	0.047	1.25
Position mother (ref=father >6 yrs older)			
- Father 0-6 years older than mother	-.056***	0.013	0.95
- Father younger than mother	-.199***	0.029	0.82
Polygamous household	-.116***	0.015	0.89
Uncle in household	-.060**	0.024	0.94
Aunt in household	.009	0.024	1.01

Table 5.2 Continued

	β-coefficient	S.E.	Exp(β)
Context factors			
Living in rural area	-.525***	0.082	0.59
Level of development (district)	-.014***	0.003	0.99
Educational level (cluster)	.148***	0.014	1.16
Position women (district)	.026	0.021	1.03
Polygamy (district)	-1.80***	0.355	0.16
Year	.050***	0.008	1.05
Variance components			
District level (3)			
- Variance intercept schooling	.438***	0.027	
- Random effect covariance Gf	.042***	0.013	
- Random effect variance Gf	.040***	0.010	
Cluster level (2)			
- Variance intercept schooling	.766***	0.031	
- Random effect covariance Gf	-.050***	0.015	
- Random effect variance Gf	.662***	0.040	

***P<0.01 **P<0.05 *P<0.1 (n=898.006 of which 61.281 living with a grandfather and 655.783 is attending school).†The model includes the full set of country-level fixed effects dummies to control for confounding and clustering at the national level

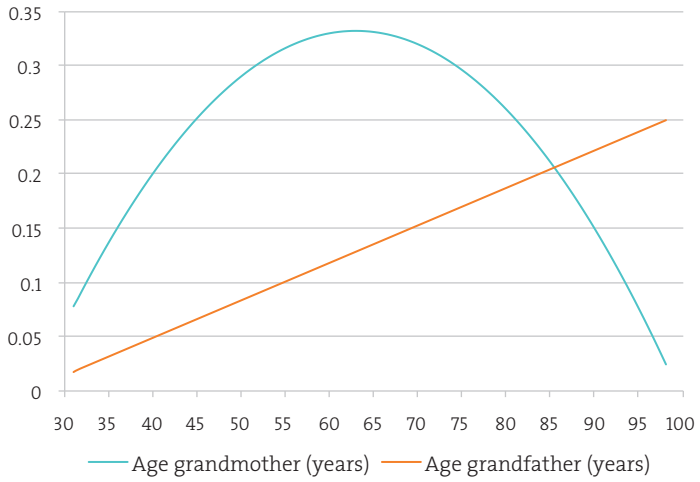
Characteristics of grandparents

Grandmother's co-residence is also positively associated with children's schooling. When controlling for confounding factors at household and context level, the odds of being in school are about 39% higher for children with a co-residing grandmother. The strength of the grandmother effect depends nonlinearly on her age. If the grandmother is young or old, the effect is weaker than when she is in her middle age. The shape of the relationships is displayed in Figure 5.2.

Figure 5.2 shows that the grandmother effect is strongest for grandmothers around the age of 65 and that for young (under 50) or very old (over 90) grandmothers it is much weaker. In contrast to grandmother's age I did not find a non-linear association between the grandfather effect and his age. Older grandfathers seem to be able to contribute more to the schooling of their grandchildren than young grandfathers.

The findings are in line with the idea that young grandparents may be less of a resource as they are reproductive themselves. In case of (very) old grandparents the results indicate that grandmothers may be more of a burden than a resource

Figure 5.2 Log odds of being in school and age of co-residence grandparents



for the household. However, for grandfathers exactly the opposite effect is observed. The results point to a grandfather who is increasingly important for children's schooling when he becomes older.

Furthermore, I find that the level of education of grandparents is positively associated with schooling. For grandmothers this relationship is somewhat stronger than for grandfathers. The random effect variances and covariances related to the co-residence of a grandfather are presented at the bottom of Table 5.2. The grandfather effect varies substantially across districts and clusters. The (co)variances are highly significant and sizable.

Other confounding factors

The models perform in line with what is already known with respect to the educational participation of children (e.g. Huisman & Smits, 2009; 2015). Table 5.2 presents the results of all other factors in the model. Children's schooling rates are higher when their parents are higher educated, not absent or dead and their mother is employed. Schooling rates are also higher when the household is wealthier, father is a 'non-farm' worker, when there are less brothers in the household and there is a more traditional situation with regard to the age difference between parents (father older than mother). Educational participation is also positively associated with children living in an urban area and in an area with higher educational levels.

Children are less in school when they are living with their uncle. District level of development has a negative sign, which is unexpected. Similar to the findings in chapter 3 and 4 this is probably due to some multicollinearity with household level of development, as both are based on the same wealth index. Indeed, when household level wealth is removed from the models, the coefficient of district level of development becomes positive. This multicollinearity is not problematic for the outcomes regarding the grandfather effect, as it is between two control factors in the models (P. D. Allison, 2012; Voss, 2004). Removing either or both wealth-based variables from the models does not affect these outcomes at all. Given that the models perform well in all other respects, I accept them as good models for studying the effect of grandfather's co-residence on children's schooling.

The role of the context: interaction effects

Interactions between the grandfather effect and all other variables in the model were tested and the significant interactions were added to the model. There are a substantial number of significant interactions between grandfather's co-residence and variables at the household level (Table 5.3). A first important interaction is with the age of the grandchild. As grandchildren grow older, the importance of a co-residing grandfather increases. Second, girls seem to profit more of the presence of their grandfather than boys. For girls, the odds of being in school increase by 25% ($P<0.01$ not in table) in households with a co-residing grandfather, whereas for boys this increase is only 7% and not significant (not in table).

Presence of a grandfather is particularly important if the mother is dead or missing from the household. In those situations, the presence of a grandfather increase the odds of being in school by 27 to 40% respectively. Interestingly, in case of a dead or missing father, a co-residing grandfather does not make a significant difference for children's schooling. Hence it seems that grandfathers may replace a missing mother, but less so a missing father.

In households with a co-residing grandmother or where the mother is older than the father, the presence of a grandfather is less important. In case of older grandmothers the opposite effect is observed.

Table 5.3 β-coefficients, standard errors and odds ratios for the significant interaction effects with grandfather's co-residence and schooling as dependent variable

Main effects presence grandfather	β	S.E.	Exp(β)
Grandfather (Gf) in household	.145***	0.040	1.16
Interaction effects grandfather			
Gf * Age child	.027***	0.007	1.03
Gf * Sex is girl	.148***	0.028	1.16
Gf * Mother alive, not in household	.340***	0.038	1.40
Gf * Mother dead	.240***	0.056	1.27
Gf * Grandmother in the household	-.264***	0.052	0.77
Gf * Age grandmother	.007**	0.003	1.01
Gf * Father younger than mother	-.187***	0.078	0.83

***P<0.01 **P<0.05 *P<0.1

There are no significant interactions with characteristics of the context in which the household is situated. Both education (at cluster level) and level of development (at district level) show no significant interactions with the grandfather variable. This seems to indicate that presence of a grandfather is not more favourable for children's schooling in situations where schooling opportunities are already rather good. In districts where the age difference between spouses is smaller, the effect of the presence of a grandfather also does not differ. No significant interaction effect of living in a polygamous household was found, which indicates that the effect on children's schooling of a co-residing grandfather does not significantly differ from children not living in polygamous households.

Grandfathers are not more important if the household is situated in a rural or an urban area. No significant interaction between the grandfather effect and year of survey was found, indicating that the importance of a co-residing grandfather is more or less stable over time.

5.6 Conclusion and discussion

On the basis of data on almost 900.000 children aged 7–15, living in 33 SSA countries, I find evidence that children living with their grandfather have higher odds of being in school than children who are not living with their grandfather. Children with a co-residing grandfather on average have 16% higher odds of being in school. This effect is quite substantial, even though it is weaker than the effect

of a co-residing grandmother (who increases the odds of being in school by 39%). The finding of a positive grandfather effect is in line with the *generative grandfathering* framework of Bates (2009), which supposes grandfathers to actively support and guide the next generation during their *generative* stage of life (ages 40-64).

I also expected the degree and quality of generative work grandfathers put forth to their grandchildren to vary and to depend upon the characteristics of the grandfather, in particular their educational level and age. Regarding their educational level, I argued that grandfathers who have experienced the benefits of good education might be better equipped to teach, instruct and coach their grandchildren. It might also make them more eager to teach their grandchildren and to stimulate them to go to school than grandfathers with no or less education. This expectation is supported by the results. The level of education of co-residing grandfathers is positively associated with the schooling of their grandchildren.

For grandfather's age I hypothesized that when grandfathers get older, they become more emotionally expressive and affectionate towards their grandchildren and may wish to teach about interpersonal relationships and to transfer values to them (Fuller-Thomson & Minkler, 2001; Waldrop et al., 1999). This hypothesis is also confirmed by the results (see Figure 5.2). The effect of the presence of a grandfather is more positive if the grandfather is older. I also hypothesized that at some point the grandfather would become too old to take care of his grandchildren and become a drain for the household, but this expectation was not supported by the data. This might have to do with the fact that the number of observations of very old grandfathers in the dataset is limited.

To gain insight into the circumstances under which a grandfather is more or less important for children's schooling, an interaction analysis was performed. An important finding of this analysis is that there is a significant positive interaction between grandfathers' co-residence and their grandchildren's age. Hence the presence of a grandfather is more positive for the schooling of older grandchildren. This finding supports my hypothesis that grandfathers might be particularly focused on the societal position of their grandchildren, because the level of respect they gain in society might depend on the societal success of their grandchildren. Because this societal success of the grandchildren may depend to a substantial degree on the level of schooling they obtain, grandfathers have an incentive to keep their children in school and to help them to move on from primary to secondary education.

Based on previous studies, in which granddaughters tend to report closer contact with grandmothers and grandsons with grandfathers, I expected boys to benefit more from a co-residing grandfather than girls (Hagestad & Speicher, 1981; Mann & Leeson, 2013). However, the results show the opposite effect. Girls profit

more from a co-residing grandfather than boys. This might indicate that grandfathers also take over (household)tasks that otherwise would have been done by girls. It might also have to do with the overall weaker position of girls compared to boys in African households, which implies that for girls more improvement is possible than for boys and that additional resources (in this case the support given by the grandfather) might benefit them more (convergence).

The interaction analysis further reveals that the grandfather effect is stronger when the mother is dead or missing in the household. However, it is hardly affected by the absence or death of the father. This might be due to the fact that African mothers are more important for children's schooling than African fathers. The effect of a missing mother on African children's schooling is much stronger than that of a missing father (e.g. Case & Ardington, 2006; Evans & Miguel, 2007; Lloyd & Blanc, 1996; Parker & Short, 2009). Households with a missing mother therefore might be more in need of a helping grandfather than households with a missing father. At least, when there is no grandmother in the household. The interaction analysis shows that the effect of a co-residing grandfather is less strong if there is also a grandmother present. Hence grandfathers and grandmothers are to a certain extent substitutes of each other. Either of them can take over household tasks or may contribute in other ways that increase the possibilities of children to go to school. When the grandfather and grandmother are together in the household, the individual contribution of both of them decreases. However, this also depends on grandmother's age, as the importance of grandfathers for children's schooling increases significantly if the grandmother is older. So African grandfathers and grandmothers also supplement each other to a certain extent.

A little surprisingly is that I find no significant interactions with socio-economic factors at household or context level. My idea that grandfathers might be more important under more difficult circumstances or in situations of scarcity are thus not confirmed by the data. Also my expectations regarding the role of cultural factors, are not confirmed by the data. Given the negative effects of polygamy on child survival documented in earlier research (e.g. Omariba & Boyle, 2007; Strassmann, 2011), I was wondering whether the grandfather effect on schooling would be affected by polygamy. This turned out not to be the case. Neither at household level, nor at community level, polygamy had a significant effect. Regarding the strength of the relative position of fathers versus mothers in the household, I found that in the rather unusual situation that the mother of the child is older than the father, having a co-residing grandfather is less important for children's schooling. Hence a weak position of the father seems to go together with a weaker position of the grandfather.

This study is the first to document a positive effect of the presence of a grandfather on the well-being of children in SSA. Earlier studies for this region did not find any grandfather effect, neither on young children's survival chances (Borgerhoff Mulder, 2007; Gibson & Mace, 2005; Sear et al., 2000; Sear, 2008) nor on children's schooling (Parker & Short, 2009). This might have to do with the relatively small scale of these studies, the focus on very young children of the four African studies, or the fact that those studies did not control for all relevant socio-demographic factors. The fact that the grandfather effect is substantially weaker than the grandmother effect probably also plays a role. A large database and powerful design were needed to make it visible against the background of confounding factors.

Some caution is required regarding my conclusions, as this study has several limitations. First, it is based on cross-sectional data. Hence, although important new information is obtained on the association between grandfathers' co-residence and children's schooling and on the variation of this relationship across circumstances, no strict conclusions in terms of causal relations can be drawn. Second, as the data does not contain information on non-residing grandfathers, it was not possible to say something about the distance gradient in grandfather support. Grandfathers who live in the vicinity of their (grand) children are probably better able to support them than grandfathers who live farther away. Insight into the nature of this relationship is essential for policymakers and social agents who want to strengthen existing family ties in order to improve the position of children. Further research is therefore needed on this distant gradient, as well as on some other missing factors, like the lineage of the grandfather and the role played by local organizations, like schools, governmental services and NGO's.

In sum, I found evidence in favour of the existence of a positive grandfather effect on children's schooling across a broad range of circumstances in the SSA context. The effect is particularly strong for older children, for girls and when the grandfather is older. Grandfathers and grandmothers are to a certain extent substitutes of each other. However, if both a grandfather and a grandmother are present in the household, the grandfather effect becomes negative. This suggests that grandfathers tend to lean to a certain extent on their wife when they are old and that grandmothers have less energy left for their grandchildren if their husband is also present. Compared to earlier research this study is a major step forward, as it provides -- for the first time -- a broad comparative analysis of the role played by context factors for the relationship between grandfathers' co-residence and child well-being, in particular children's schooling. The findings make clear that grandfathers should not be overlooked when designing policies aimed at strengthening the position of grandparents and children in the SSA context.

The analysis in previous chapters (3,4,5) were focused on the role of grandparents related to the schooling of their grandchildren aged 7-15. In the next chapter I will focus on the period prior to primary and secondary education. I will study the role of grandmothers and grandfathers in relation to children's growth (stunting) when they are 6-60 months old.

Chapter 6

Grandmothers, grandfathers and children's stunting in sub-Saharan Africa [6]

6 Chapter was presented at the RC28-conference in New York, July 2017 and is accepted for presentation at the XXVIII International Population Conference in Cape Town, November 2017.

Abstract

Globally an estimated 159 million children under 5 years of age are being too short for one's age (stunted). More than one third of these children is living in Africa. Given the substantial number of SSA children living in households with co-residing grandparents and the negative effects of stunting on productivity and economic growth, gaining insight into the role grandparents play for children's stunting, has become increasingly important.

In this chapter a database with DHS-information on 357.340 children aged 6-60 months living in 31 SSA countries is used to study the relationship between grandparents and children's stunting. By applying fixed effects logistic regression analysis, the strength of the relationship between grandparental co-residence and children's stunting is examined. Interaction analysis are used to explore how this relationship is moderated by the characteristics of the household and the context in which the household is situated.

The presence of a grandmother plays an important role regarding the reduction of children's stunting in SSA. The odds of being stunted are about 5% lower for children living with their grandmother compared to children who do not. The effect is sizeable and is not influenced by household and context characteristics, except for grandmother's age and the educational level of the father.

The co-residence of a grandfather seems to play a significant role regarding their grandchildren's stunting only in particular situations. Especially girls and children who are living in a polygamous household seem to profit of living with their grandfather. However, children who are living with a co-resident grandfather in a less wealthy household, or together with their uncles, or who were small at birth seem to be disadvantaged when living with a grandfather.

6.1 Introduction

This chapter examines the relationship between co-residing grandparents and linear growth failure, or "stunting", of their grandchildren. Globally an estimated 159 million children under 5 years of age are being too short for one's age. More than one third of these children is living in Africa. Although the relative figures show a downward trend, the absolute number of stunted children in Africa is rising due to high fertility levels (Unicef et al., 2014). Inadequate nutrition and (infectious) diseases in the first 1000 days of a child's life play an important role in stunting (Black et al., 2013; Unicef, 2007; Unicef et al., 2014; WHO, 2012). The effects of growth retardation on individuals and societies are detrimental in the long run. Important factors for economic development like health, economic productivity, physical and cognitive development, are negatively associated with stunting (Crookston et al., 2011; Hoddinott et al., 2013; Hoddinott et al., 2008; Martorell et al., 2010). Given the substantial number of SSA children living in households with co-residing grandparents and the negative effects of stunting on productivity and economic growth on this continent (Lutz et al., 2008; UNESCO, 2014), gaining insight into the role grandparents play for children's stunting, has become increasingly important. This chapter aims to provide this insight. I determine the strength of the relationship between grandparental co-residence and children's stunting and examine how this relationship is influenced by the circumstances in which the household is situated. In this way, I aim to provide new empirical knowledge that may contribute to the design of policies that help to improve the life chances of children.

So far, most literature examining children's stunting has primarily been focussing on the role of mother-child dyads, child nutrition and health factors (Bhutta et al., 2008; Black et al., 2013; Chirande et al., 2015; Darteh et al., 2014; Keino et al., 2014; Walker et al., 2016; Willey et al., 2009). This is regrettable because other household factors and the environment of the household might be important as well. For example the presence of other household members like grandparents. Literature examining the role of grandparents related to children's stunting is scarce and consists mostly of studies of specific (ethnic) groups or regions (see Sear & Mace, 2008 for a broad overview). The results of these studies show a varying picture of the relationship between grandparents and children's well-being and may provide an in-depth understanding of the situation of those groups or regions. However, they give less insight into the role of grandparents across the African continent and how the relationship with their grandchildren is influenced by varying socio-economic, demographic and cultural context factors of households. To study the role of context factors in an effective (multivariate) way, information is needed on a large number of contexts and within each context

on a large number of households. Such a multilevel database, with many households in many contexts, has not yet been used in research on the role of grandparents and children's stunting in Africa. I have built a database with information on 357.340 children aged 6-60 living in 31 sub-Saharan African (SSA) countries. By applying multilevel logistic regression analysis on this database, I aim to answer the following research questions:

- What is the relationship between the co-residence of grandparents and children's stunting?
- To what extent do socio-economic, demographic and cultural characteristics at the household and context level influence this relationship?

Because the influence of context factors on the grandparental effect is studied at the level of sub-national regions and communities within 31 countries, this approach is a major step forward. This means that I have considerable power to study effects of context factors in a multivariate way and can answer questions about the role of the context better than in earlier studies.

In the next section, I first discuss the importance of stunting and the reasons why grandparents in SSA may be living with their (grand)children. Then the theoretical framework that will be used to guide this research is presented and hypotheses are formulated. Section 6.4 describes the data and methods that will be used. In section 6.5 the results are presented. Concluding remarks are given in section 6.6.

6.2 Background

Grandparents and stunting

According to the World Health Organization (WHO), children are stunted when their height-for-age Z-score (HAZ) is two standard deviations below the WHO child growth standard median (WHO, 2012). Globally an estimated 159 million children under 5 years of age are being too short for their age. Almost one third of these children is living in Africa. Although the relative figures show a downward trend in the period 1990-2014 (decreased from 42% to 32%), the absolute number of stunted children in Africa has risen from 47 to 58 million in this period due to the high fertility levels (Black et al., 2013; Unicef et al., 2014).

The effects of growth retardation on individuals and societies are detrimental, particularly in the long run. Next to cognitive development, other important factors for economic development like health and economic productivity are significantly associated with stunting as well (Crookston et al., 2011; Hoddinott et al., 2013; Hoddinott et al., 2008; Martorell et al., 2010). According to Economists stunting can reduce a country's GDP by up to 3% (The World Bank, 2006).

In 2012 the WHO has declared stunting of children under five a global target and strives for a 40% reduction of stunting by 2025. Inadequate nutrition and (infectious) diseases in the first 1000 days of a child's life play an important role in growth problems. Policies aiming at bringing down stunting levels are therefore frequently focussing on the improvement of the quantity and quality of nutrition. Mothers play an important role in this respect. They are responsible for optimal breast- and complementary feeding and the control of diseases (WHO, 2012). Given the close connection between mothers and young children, especially in the period of early childhood, initially much research in the field of stunting has been focusing on mother's behavior and her characteristics. The role and influence of grandparents has received less attention (Aubel, 2012). This is regrettable because most mother-child dyads are not self-contained units, but are part of an extended family system in which mothers are supported and influenced by other family members and in particular by grandmothers. Hawkes et al. (1997), for example, observed that Hadza-grandmothers in Tanzania appear to enhance the nutritional welfare of their grandchildren by helping their daughters in provisioning food for the children. In rural Gambia, maternal grandmothers may double the survival chances of a Mandinka child by taking care of their grandchildren (Sear et al., 2000). Ethiopian grandmothers had a positive effect on child survival by relieving their daughters of heavy domestic work. Non-reproductive maternal grandmothers in Ethiopia were positively associated with child height (Gibson and Mace, 2005).

Not all studies find positive grandmother effects, however. When studying the Kipsigis in Kenya, Borgerhoff Mulder (2007) found no positive effect of maternal grandmothers, which she associated with the strong patrilineal organization of the Kipsigis. Strassmann (2011) also found no positive maternal grandmother effects. Dogon girls, in fact, tend to grow faster in the absence of the maternal grandmother. According to Strassmann (2011: p.10899) this is probably the result of the hard work they have to perform for their grandmother, like weeding in the garden.

Studies in more affluent contemporary societies, like the U.S. and Europe, generally show a positive role of grandmothers (e.g. Danielsbacka et al., 2011; Dimova and Wolff, 2010; Fuller-Thomson and Minkler, 2001; Hank and Buber, 2008; Kaptijn et al., 2013), whereby the grandmothers for example delivered childcare or helped their (grand)children financially. For pre-modern societies, findings are more mixed (e.g. Beise, 2005; Jamison et al., 2002; Lahdenperä et al., 2004; Voland and Beise 2002). Lahdenperä et al. (2004) found that the presence of grandmothers in 18th and 19th century Finland and Canada was associated with less mortality among their grandchildren, but that the significance of this effect depended on grandmother's and grandchildren's age. When a grandchild was

between two and five years of age and grandmothers were under 60 at the children's birth, survival probabilities were significantly higher. Using historical data (1671-1871) of a small village in Japan (Shumon Aratame Cho), Jamison et al. (2002) noted a positive association between the presence of a maternal grandmother and child survival rates. Presence of a paternal grandmother, on the other hand, was negatively associated with the survival of boys.

Empirical research on grandfathers and children's stunting in Africa is scarce. However, there are some studies on the relationship between grandfathers and child survival in early childhood. A meta-analysis conducted by Sear & Mace (2008) gives a comprehensive overview of the relation between grandfathers and child survival. Their analysis shows that grandfathers in 4 out of 20 studies were positively associated with child survival, in 3 studies negatively and that in 13 studies there was no significant effect. For grandmothers these figures were 16, 3 and 7 studies from 26 studies respectively. These figures suggest that grandfathers are less important than grandmothers when it comes to child survival. Most of the studies included in the analysis concerned pre-modern European, Asian, North and South American countries. In the four African studies that were included, no significant connections between grandfather's presence and child survival were reported (Borgerhoff Mulder, 2007; Gibson & Mace, 2005; Sear et al., 2000; Sear, 2008).

Why are grandparents living with their (grand)children?

To increase the understanding of the role played by co-residing grandparents, a first important question to be answered is why do these grandparents live with their (grand)children? In SSA, where overall mortality levels are high and an estimated 15 million children have lost one or both of their parent(s), it is a very common situation that children come to live with their grandparents (UNAIDS, 2013). Especially when mothers die, grandmothers are usually the ones that take over the care for their grandchildren. Depending on the circumstances, the child may move to the household of the grandparent(s) or the grandparent(s) may come to live in the parental home. However, parental death is not the only reason why children are residing with their grandparent(s). In the African context, the reasons for this are diverse. In Lesotho parents leave the household due to labour migration. Grandparents and other household members take over the care of their children and parents send remittances to the household (Parker & Short, 2009). In some regions and among some groups the cultural tradition exists that one or more children remain living with their parents after marriage (e.g. Kandiyoti, 1988; Fox, 1967; Korotayev, 2003). The partners of these children then come to live in the family home and become a member of the extended family system. Under poor circumstances, sharing costs of living in this way increases survival chances

and care needs can be fulfilled more easily. Living together with their children also constitutes a natural old-age security system for the (grand)parents (Laferrère and Wolff, 2006). Over time, the situation may gradually change from one in which the grandparents are the major driving forces of the household to one in which the next generation takes over. The grandparents then become the helping hands, as long as their health allows this.

Another way in which (grand)parents and children may come to live together is when children after marriage establish their household elsewhere, but the grandparents move in later. This might for example be for financial reasons, because the grandparents need care, or because one of them has died. Depending on the health status of the (grand)parents, they may then be a resource or a burden for the household.

6.3 Theoretical framework

Grandparental co-residence: a curse or a blessing?

Grandmother's and grandfather's co-residence are the major independent variables and stunting the dependent variable of this study. I hypothesize that grandmother's co-residence is associated with lower stunting rates of their grandchildren. This *grandmother support hypothesis* is based on the expectation that grandmothers who are already living with their grandchildren have a low threshold to help their children in rearing their grandchildren. They are physically present in the household, are experienced in raising offspring and can advise and support them. This is particularly useful when their daughter(-in-law) is young and has to take care of multiple children. Malnutrition and infections in the first years after birth are important triggers for growth retardation. Breastfeeding and complementary feeding, maternal nutrition during pregnancy, vaccinations and vitamin supplements may reduce the risk of stunting (Alemayehu et al., 2015; Berendsen et al., 2016; Bhutta et al., 2008; Keino et al., 2014). Grandmothers who co-reside with their children (and grandchildren) have better opportunities to positively influence the aforementioned factors than grandmothers living elsewhere.

Additionally, from a biological perspective grandparents may be predisposed to invest in their grandchildren. This argument is supported by evolutionary theory (e.g. Hawkes et al., 1997; Hrdy, 1999, 2009; Sear et al., 2000; Sear, 2008), whereby Hamilton's (1964) inclusive fitness argument plays a central role. Individuals can enhance their inclusive fitness by reproducing themselves and/or by helping other kin with whom they share partly the same genes. This applies to both men and women, but probably more to women. According to the *classical*

grandmother hypothesis, menopause may have developed, because for older women the expected returns on producing offspring themselves may become lower than the returns on helping rearing their grandchildren and other kin in terms of reproduction. The healthy years a woman lives after menopause gives her the opportunity to increase the reproductive success of her children. In this way, she also increases her own reproductive success (e.g. Hawkes et al., 1997; Hawkes, 2004; Lahdenperä et al., 2004).

Traditionally, grandfathers are less involved in household work and are not familiar with caring tasks and helping their daughters (in law) with breastfeeding like grandmothers. I therefore do not expect to find a straightforward connection between the presence of a grandfather and children's stunting. While (grand) mothers are supposed to be focused on feeding and caring of young children, (grand)fathers might be more focused on the future achievements of their grandchildren in society. As a mentor they can teach their grandchildren and offer them wisdom and life experience (Waldrop et al., 1999). However, grandfathers might become important for young children under certain conditions. For example when parents are missing or when there is no grandmother who can help their (grand)children. In such situations grandfathers might more or less be forced into a role as caregiver and become important for the well-being of their grandchildren.

Grandparents might also be a burden to the household resources. The *local resource competition hypothesis* (e.g. Borgerhoff Mulder, 2007; Sear and Mace, 2008) predicts that altruistic behaviour of family members may be reduced when there is scarcity of local resources. Several studies support this hypothesis. Strassmann (2011) found the co-residence of a paternal grandmother to lead to a twofold higher hazard of death of a grandchild by the age of five. She attributes this to the fact that old grandmothers become net-consumers and therefore competitors with their grandchildren in the resource-poor society of the Dogon. Sear (2008) discovered that among the Chewa in Malawi child mortality rates are higher in the presence of matrilineal kin and in particular in the presence of the maternal grandmother. Sear supposed this negative effect to be caused by resource competition between kin. Borgerhoff Mulder (2007) observed, using within-population variation in land ownership in Kenya, that wealth affects the extent of kin altruism. Paternal relatives (specifically uncles from the father's side) appear to buffer young children from mortality much more effectively in rich than in poor households. To what extent there is a positive grandparental effect on children's stunting might thus depend on the circumstances, with the effect being weaker when grandparents are relatively young or old and/or when children are living under poor circumstances.

The role of the circumstances

Given the variation in grandparental effects found in previous research, an important focus of the current chapter is on the role of the circumstances. To what extent and in which way the effect of a co-residing grandparent influence children's stunting is supposed to depend on the age and educational level of the grandparents and on specific characteristics of the household and the context (research question 2). These factors are divided into resource-related factors and gender-related factors. In the next two sections, these factors are discussed. Thereafter, other relevant control factors related to stunting are being discussed.

Resource related factors

As mentioned before, the local resource competition hypothesis (Borgerhoff Mulder, 2007; Sear & Mace, 2008) predicts altruistic behaviour of family members to decline in situations of resource scarcity. In a resource-poor environment, grandparents may become competitors with their grandchildren, especially when they are old and need to be taken care of (compare Strassmann, 2011). There is also evidence that the survival probabilities of children in 18th and 19th century Finland and Canada were significantly higher when their grandmothers were under 60 at their birth (Lahdenperä et al., 2004).

However, grandparents should also not be too young. When grandparents are very young they have to put their energy in running their own households and caring for their offspring and have less possibilities to take care of their grandchildren. Young grandmothers might even still be reproductive themselves. Sear et al. (2000) for example found evidence that young children in rural Gambia are taller in the presence of non-reproductive grandmothers than with reproductive grandmothers and Hawkes et al. (1997) reports that non-reproductive Hadza grandmothers put much more effort in the acquisition of food than reproductive women/grandmothers do. Young grandfathers might have to spend their energy on earning the daily living of themselves and their households and leave the care for their grandchildren to the women in the household. Hence, regarding the relationship between the age of grandparents and their importance as a positive resource for their grandchildren I hypothesize a nonlinear (parabolic) relationship, with their contribution being highest in the middle age range (no young children of their own and not yet too old to contribute). This *parabolic age hypothesis* will be tested by looking at nonlinear effects of grandparental age in our analyses.

Resource related factors at the level of the household are income, wealth, education and employment. The availability of these resources may influence grandparental effects in several respects. For example, prevention of infections is an important factor in reducing the risk of stunting. It requires a practice of hand-washing with soap. The extent to which such behaviour will be internalised

depends among other things on the affordability of soap and the availability of safe water. Poor households often experience difficulties in access to safe water and might not be able to afford soap or give it low priority. Similarly, to provide a healthy diet to prevent children from stunting, high-quality and nutrient-rich foods are required (Prendergast & Humphrey, 2014; WHO, 2012). Poor households will probably not be able to buy these – more expensive -- foods or give low priority to food quality. Grandmothers can help mothers in this respect by assisting with food purchase and preparation. They can also take care of the young children, preventing them from playing in polluted areas. In rural areas of SSA, toilets tend to consist of pit latrines or are lacking completely and sewerage is often rudimentary. The areas surrounding villages therefore may be polluted by human and animal excreta. Caring for children by grandmothers, who also may urge them to wash their hands with soap, may prevent the children from getting infections and in this way reduce the risk of stunting.

Regarding parental education and father's occupation, there is evidence that children from better educated parents and whose fathers have a non-farm job are less stunted (Keino et al., 2014). Better educated parents and fathers with a non-fam job are better informed of what is needed for healthy growth of a child. Under such favourable circumstances, presence of grandparents might make less of a difference.

The presence of grandparents is expected to be particularly important if parents are dead or missing in the household. The data used in this study make it possible to study the effect of a missing father. The resulting single motherhood is also associated with negative effects on children's stunting (Finlay et al., 2016; Monasch & Boerma, 2004). It seems likely to assume that under these circumstances, co-residence of grandparents may be particularly beneficial to children's well-being.

Gender-related factors

Studies examining the relationship between the presence of grandparents and the well-being of grandchildren mostly report different results for boys and girls (e.g. Borgerhoff Mulder, 2007; Gibson and Mace, 2005; Jamison et al., 2002; Strassmann, 2011, Wamani, et al., 2007). Therefore gender-related factors are included in my analysis as well.

There is evidence that a stronger position of women is associated with better health outcomes for children (e.g. Hobcraft, 1993; Mukherjee and Das, 2008). In most regions of SSA, women are traditionally responsible for the day-to-day care of children and to a large extent for their economic support (Caldwell & Caldwell, 1987; Kandiyoti, 1988). Given that in regions where the position of women is stronger the position of grandmothers also tends to be stronger, the expectation is that in such regions the presence of a grandmother is particularly beneficial.

Besides the general position of women, the presence and extent of polygamy might be important too. Strassmann (2011: p.1) observed that in polygamous families, child mortality and stunting rates are significantly higher. She attributed this to the fact that polygamy creates conflicts within families associated with asymmetries in genetic relatedness. If there is more uncertainty about genetic relatedness among family members, the risk of conflict increases. Omariba & Boyle (2007) found that children from polygamous families are more likely to die compared to those from monogamous families. Kandiyoti (1988: p.277) argues that in case of polygamy the continuing obligations of both men and women to their own kin do not foster a notion of the family or household as a corporate entity. However, Lawson et al., (2015) did not find evidence that children living in polygamous households in Tanzania were worse off compared to children who did not. Hence, whether the effect on stunting of the presence of grandparents in such families is stronger or weaker than in a monogamous family remains an empirical question to be answered in my analyses.

Control factors

Other factors that may affect stunting are gender of the child and the size and composition of the household. Empirical evidence shows that boys are more likely to be stunted than girls across multiple countries in SSA (Berendsen et al., 2016; Keino et al., 2014; Wamani, et al., 2007). Children with more brothers and sisters are more likely to compete for the available resources, so that the risk of stunting is probably also larger in those households (Keino et al., 2014). I also control for important health factors like if the child has ever received vaccinations, a vitamin A dose in the first two weeks after birth and a child's size at birth. Small birth size is associated with a higher risk of stunting (Unicef et al., 2014; Unicef, 2007; WHO, 2012).

6.4 Data and methods

Data

For this study, combined datasets from the Demographic and Health Surveys have been used (DHS; www.dhsprogram.com). The data are derived from the Database Developing World (www.datdevworld.org). DHS are large, nationally representative household surveys. For each survey, non-overlapping area units (often enumeration areas) are randomly selected. These areas (called 'clusters' henceforth) are usually communities, villages, or city quarters. In the selected clusters, all households are listed and a random sample of 25-30 households is selected for the interviews. The DHS consists of a household survey, in which basic information is collected of all household members, and separate women's and

men's surveys. In the women's surveys, all usual resident women aged 15 to 49 are invited for an oral interview. In this interview, information is obtained on socioeconomic, demographic, and health related issues.

To get a maximum discriminatory power, the data of all available standard DHS surveys for SSA countries held since 2000 have been pooled. The combined dataset contains information derived from 69 surveys on 357.340 children aged 6-60 months living in 31 countries. The household level data have been supplemented with context information at the level of districts and communities/clusters. To get representative samples of the countries, the household weights provided by DHS are used in all analysis. Children younger than 6 months are excluded from the analysis, because of the difficulty of differentiating between foetal growth and stunting. Missing or unrealistic cases (12.314) on the variables parental education, (grand)parental age, polygamy, wealth, number of brothers and sisters, have been removed from the dataset. Unrealistic cases are parents with an age below 12, mothers above 50 or grandparents aged below 25. My analysis therefore covers 345.026 children (171.669 girls and 173.357 boys) living in 31.014 local communities (sample clusters) within 1156 sub-national regions (called 'districts' henceforth) of 31 SSA countries. Structural missings on characteristics of parents and grandparents who were missing in the household (e.g. education or occupation of a death father) are addressed using the dummy variable adjustment procedure, which leads to unbiased estimates of these variables (Allison, 2001; Little and Rubin, 2002).

Method and Variables

The dataset is characterized by a hierarchical structure. Households are nested within sample clusters, within districts and within countries. Three-level logistic regression analysis is used to address the nesting of the households within sample clusters and districts. Fixed effects dummies are included at the national level, to control for the nesting within countries. This strategy allows us to fully control for clustering and confounding at the national level, while retaining the possibility to study the role of context factors at the district and cluster level.

To analyse the data, multilevel logistic regression analysis (random slopes) is used, with stunting as dependent variable. 'Stunting' is a dummy variable indicating whether (1) or not (0) children aged between 6 and 60 months were stunted at the time of the interview. Children are stunted when their height-for-age Z-score (HAZ) is two standard deviations below the WHO child growth standard median (WHO, 2012). Stunting information is derived from the women surveys which are part of the DHS-household surveys. As a consequence there are no children in my sample with a missing mother.

Children co-resident with their grandparents are identified in the DHS-data by using the household roster, which defines for all household members the relationship to the household head. Children are identified as living with a grandmother if (1) they are grandchildren of a female household head; (2) they are grandchildren of a male household head whose wife is also living in the household; (3) they are children of the household head, and the mother or mother in law of the household head is also living in the household; (4) they are children of a brother or sister of the household head, and the mother of the household head is also living in the household. All other children living in the household, including adopted and foster children, are considered as not living with their grandmother. In situation (2) the grandmother might not in all cases be the biological grandmother of the child, because of polygamy. For polygamous households, there is not enough information available to determine which of the household head's wives the 'real' grandmother is. To control for this situation, a dummy variable is added to the models indicating whether (1) or not (0) the household is a polygamous household (the head has more than one wife). To find out whether this situation influenced the grandmother effect, the interaction of this variable with the grandmother dummy has been tested. This interaction was not significant.

Children are identified as living with their grandfather if (1) they are grandchildren of a male household head; (2) they are grandchildren of a female household head whose husband is also living in the household; (3) they are children of the household head, and the father or father in law of the household head is also living in the household; (4) they are children of a brother or sister of the household head, and the father of the household head is also living in the household. All other children living in the household, including adopted and foster children, are considered as not living with their grandfather or grandmother. Given the restricted information on the relationships within the households, it cannot be completely precluded that some of these children still live together with a grandfather or grandmother, for example if they belong to the categories "Other family members" or "Not related household members". However, given that the number of children in the data who belong to these categories is small (5,2%), the number of them living with their grandparent(s) is expected to be negligible.

Other independent variables are age of child measured in months, sex of child (boy=0, girl=1) and resource-, gender and health-related factors at household and context level. The presence of the father is measured with a dummy variable indicating whether (1) or not (0) he is missing in the household. Age of the child and age of its (grand)parents are interval variables. The variables 'number of sisters', 'number of brothers' are interval variables ranging from 0 to 10 or more.

The models contain a number of control factors that are known or can be expected to influence children's stunting. Household wealth, father's occupation, parental education and employment of the mother are factors that are known to influence children's body growth (Evangelista de Carvalho Filho, 2012; Glewwe & Jacoby, 2004; Mingat, 2007; Shavit & Blossfeld, 1993; Smits & Gündüz-Hoşgör, 2006). Other control factors that are known to influence body growth are: ever received vaccinations, received a vitamin A dose in the first two months after delivery and birth size which is a categorical variable running from 1-5 (1=very large, 5=very small) (Berendsen et al., 2016; Espo et al., 2002).

Because income is lacking in the DHS data, household wealth was measured by the International Wealth Index (IWI; Smits and Steendijk, 2015), a comparative asset-based wealth index. IWI indicates to what extent the household owns a basic set of assets, valued highly by people across the globe, such as TV's, cars, telephones and housing characteristics like the quality of the floor material and toilet facility. Education of the (grand)parents is measured in years of education completed which ranges from 0 to 16 years. Occupation of the father is measured by three dummy variables, indicating whether (1) or not (0) the father was employed in a farm, lower non-farm (sales, services, manual), or upper non-farm (professional, technical, managerial, clerical) occupation. Employment of the mother is measured by a dummy variable indicating whether (1) or not (0) the mother aside from her housework did any other work last week. The questions used in the DHS surveys for measuring women's employment are: "Aside from your own housework, have you done any work in the last seven days?" And if the answer was no: "As you know, some women take up jobs for which they are paid in cash or kind. Others sell things, have a small business or work on the family farm or in the family business. In the last seven days, have you done any of these things or any other work? Women who answered yes on one of these questions are considered as being employed.

To indicate the relative position of the mother in the household I follow earlier research (Blanc & Wolff, 2001; Luz & Agadjanian, 2015; Spierings et al., 2010) and use the age difference between parents (age mother minus age father).

To study the importance of context factors, socio-economic characteristics (level of development, urbanization, education) and gender related cultural characteristics (age difference between spouses, polygamy) of the region have been added to the models. Level of development is indicated by the mean of the International Wealth Index in the region. Given that this index at the national level is highly correlated with the Human Development Index and with GNP per capita (Smits and Steendijk, 2015) it is expected to be a good development indicator at the sub-national level as well. Urbanization is measured by a dummy variable indicating whether (1) or not (0) the household is living in a rural area. Education

is measured by the mean years of education of people aged 20-40 in the area. The relative position of women in the context where the household lives is indicated by the average age difference between parents as an interval variable and by the percentage of polygamous households in the area. Polygamous households are households where the male household head has more than one wife.

Given that for African countries hardly any indicator is available at the sub national level, context factors are created by aggregating household level variables to the sample cluster and district level. Sample clusters are villages or neighbourhoods and therefore reflect the nearby community in which the household lives very well. Using context variables at the cluster level therefore seems preferable over using such variables at the more distant district level. However, the sample clusters in the data are rather small (at most 30 households and often much less). This means that there is little variation at that level and measurement is imprecise. At the district level, sample sizes are much larger. There is also evidence that context effects can be caught rather well by more distant variables (Smits et al., 2005), although education at cluster level forms an exception. Kravdal (2006) found that the context level of education works well at cluster level. Therefore context education was included at cluster level and the other context factors at district level.

To find out whether and in which ways the effect of a co-residing grandparent differs across circumstances, interactions between the grandparental dummies and most of the other variables at household and context level are tested. These other variables include the gender of the (grand)child, presence of its father, socio-economic and gender factors at household and context level. In the interaction analysis, centred versions of the involved variables are used, so that the main effects can be interpreted as average effects.

6.5 Results

Descriptive statistics

Of the children (aged 6-60 months) in my sample 14% is living with at a grandmother, 6.8% is living with a grandfather, and 5.8% is living with both a grandmother and grandfather (see Table 6.1). Regarding stunting, 42% of children is too short for one's age according to WHO standards.

The average age of grandmothers in the sample is 57.4 years against 62.5 years for grandfathers. Of the children, 21.3% is living without a father in the household. There are no missing mothers in this sample, because the stunting information has been derived from the women surveys. Most of the children in the population are living in rural areas (72%). Grandfathers have obtained on average somewhat

Table 6.1 Descriptive statistics: Percentages, means of characteristics of children aged 6-60 months

Variables	%, mean	Min	Max	SD
Stunting (dependent variable)	42%	0	1	0.49
Household factors				
Grandmother in household	14%	0	1	0.35
Grandfather in household	6.8%	0	1	0.25
Age grandmother	57.4	25	98	4.36
Age grandfather	62.5	25	98	3.02
Education grandmother (years)	1.82	0	20	1.18
Education grandfather (years)	3.34	0	21	1.13
Sex is girl	49.8%	0	1	0.50
Age child (months)	1.91	6	60	1.44
Age mother	29.2	15	50	6.91
Age father	38.2	13	98	9.00
Number of Sisters	1.67	0	10	1.59
Number of Brothers	1.71	0	10	1.67
Father not in household	19.3%	0	1	0.39
Father dead	2.0%	0	1	0.14
Vaccinations (ever received)	79.9%	0	1	0.26
Vitamin A (in first two months after delivery)	39.3%	0	1	0.39
Size at birth (1=very large, 5=very small)	2.73	1	5	0.96
Household wealth (IWI)	25.7	0	100	21.8
Education father (years)	4.78	0	16	4.21
Education mother (years)	3.77	0	16	4.20
Mother employed	63%	0	1	0.48
Occupation Father:				
Farm (reference category)	58.9%	0	1	0.49
Lower non-farm	32.9%	0	1	0.47
Upper non-farm	8.20%	0	1	0.27
Relative position mother (age mother-age father)	-8.72	-79	32	6.67
Polygamous household	12.6%	0	1	0.33
Context factors				
Living in rural area	72.1%	0	1	0.45
Level of development (district)	27.2	0.99	80.5	16.8
Relative position women (district)	-8.95	-16.7	-1.93	2.55
Educational level (years, district)	3.0	0	10.8	1.42
Polygamy (district)	27.9%	0	1	0.18

Source: DHS (2000-2014)

more years of education (3.3 years) than grandmothers (1.8 years). Parents are better educated than grandparents and on average fathers (4.8 years) are better educated than mothers (3.8 years).

Multivariate analysis

Table 6.2 presents the results of the multilevel logistic regression analyses with the stunting of children aged 6-60 months as dependent variable. The control factors generally show associations with the variable stunting that are in line with the literature. The odds of being stunted are higher for boys, for children with more siblings, for children who are living without their father, who are small at birth and who live in rural areas. The associations between children's age as well as their mother's age and stunting are curvilinear, with higher stunting levels at low and high age.

Regarding the relationship between the co-residence of grandparents and children's stunting, I observe a significant negative association for a co-residing grandmother.

When controlling for confounding factors, the odds of being stunted are 5% lower for children who are living with their grandmother compared to children who do not. Regarding the co-residence of a grandfather, I observe no significant general effect. Hence for the reduction of stunting of young children my results indicate that grandmothers are more important than grandfathers.

When looking at the characteristics of the grandparents that might influence stunting (age and educational level), I notice a significant nonlinear effect of grandmother's age. Children living with older grandmothers have lower odds of being stunted than children living with younger grandmothers. However, when the grandmother is very old, the likelihood of being stunted increases again. The grandmother effect is most positive for grandmothers between 55-68 years of age (see Figure 6.1). Age of the grandfather is not significantly associated with children's stunting. Regarding the educational level of the grandparents, the situation is reversed. While the educational level of the grandfather is significantly and negatively associated with children's stunting, no association between grandmothers education and stunting is observed. This might have to do with the fact that there are relatively few grandmothers with more than a couple years of education.

Table 6.2 Multilevel logistic regression analyses of stunting of children aged 6-60 months in 31 SSA countries as dependent variable (log odds, standard errors and odds ratios)†

	Model 1		Model 2	
Characteristics grandparents	β (S.E.)	Exp(β)	β (S.E.)	Exp(β)
Intercept	.130 (0.101)		.130 (0.101)	
Grandmother in household	-.055** (0.017)	0.95	-.052** (0.017)	0.95
Age grandmother	-.017* (0.007)	0.98	-.017** (0.007)	0.98
Age grandmother square	.0001**(0.0001)	1.00	.0001** (0.0001)	1.00
Education grandmother	-.003 (0.004)	1.00	-.005 (0.004)	1.00
Grandfather in household	-.014 (0.021)	0.99	-.022 (0.021)	0.98
Age grandfather	-.002 (0.002)	1.00	-.002 (0.002)	1.00
Education grandfather	-.008 (0.004)	0.99	-.013** (0.004)	0.99
Household factors				
Age child (months)	.110***(0.002)	1.12	.110*** (0.002)	1.12
Age child square	-.001***(0.000)	1.00	-.001*** (0.000)	1.00
Sex (boy=0, girl=1)	-.263***(0.008)	0.77	-.264*** (0.008)	0.77
Age mother	-.026***(0.005)	0.97	-.026*** (0.005)	0.97
Age mother square	.0002* (0.000)	1.00	.0002* (0.000)	1.00
Age father	-.0001 (0.001)	1.00	-.0001 (0.000)	1.00
Number of sisters	.029***(0.003)	1.03	.029*** (0.003)	1.03
Number of brothers	.034***(0.003)	1.03	.034*** (0.003)	1.03
Uncle in household	-.004 (0.025)	1.00	-.002 (0.025)	1.00
Aunt in household	-.006 (0.025)	1.00	-.007 (0.025)	1.00
Father not in household	.035** (0.013)	1.04	.037**(0.012)	1.04
Father dead	-.004 (0.032)	1.00	-.002 (0.032)	1.00
Education father (years)	-.009***(0.002)	0.99	-.008***(0.002)	0.99
Education mother (years)	-.033***(0.002)	0.97	-.032***(0.002)	0.97
Mother employed	-.024* (0.010)	0.98	-.024* (0.010)	0.98
Occupation father (ref=farm)				
- Lower non-farm	-.041** (0.016)	0.96	-.040* (0.016)	0.96
- Upper non-farm	-.065* (0.027)	0.94	-.063* (0.027)	0.94
Position mother (age mother–age father)	.002 (0.002)	1.00	.002 (0.002)	1.00
Vaccinations (ever received)	-.033 (0.020)	0.97	-.032 (0.019)	0.97
Vitamin A (in two months after delivery)	-.008 (0.012)	0.99	-.008 (0.012)	0.99
Size at birth (1=very large, 5=very small)	.173***(0.006)	1.19	.173***(0.006)	1.19
Household wealth (IWI)	-.014***(0.000)	0.99	-.014***(0.000)	0.99
Polygamous household	.081***(0.016)	1.08	.081***(0.016)	1.08

Table 6.2 Continued

	Model 1		Model 2	
Context factors	β (S.E.)	Exp(β)	β (S.E.)	Exp(β)
Living in rural area	.113** (0.044)	1.12	.112** (0.044)	1.12
Level of development (district)	-.001 (0.002)	1.00	-.001 (0.002)	1.00
Educational level (cluster)	-.016** (0.006)	0.98	-.016** (0.006)	0.98
Position women (district)	.022* (0.010)	1.02	.022* (0.010)	1.02
Polygamy (district)	.144 (0.152)	1.16	.144 (0.151)	1.16
Year	-.013***(0.004)	0.99	-.013***(0.004)	0.99
Random part (random slope model)				
District level (3)				
- Variance intercept stunting	.088***(0.006)		.088***(0.006)	
- Variance random slope grandmother	.007 (0.008)		.008 (0.008)	
- Variance random slope grandfather	.000 (0.000)		.000 (0.000)	
Cluster level (2)				
- Variance intercept stunting	.195***(0.007)		.195***(0.007)	
- Variance random slope grandmother	.169***(0.030)		.166***(0.030)	
- Variance random slope grandfather	.257***(0.048)		.239***(0.048)	

***P<0.001 **P<0.01 *P<0.05 (n=345.026 of which 48.431 is living with a grandmother, 23.371 is living with a grandfather and 144.950 is stunted). †Both models include the full set of country-level fixed effects dummies to control for confounding and clustering at the national level

The role of the context: interaction effects

I tested for interactions of the grandmother and grandfather effects with all other variables in the model. Only significant interactions were kept in the final model (Model 2) and are presented in Table 6.3. There are a substantial number of significant interactions of grandfather's co-residence with household level factors. For grandmother's co-residence, only one interaction is significant: The effect of a co-residing grandmother depends on the educational level of the father. If the father has a low educational level, the positive effect of a co-residing grandmother for children's stunting is stronger.

Table 6.3 β-coefficients, standard errors and odds ratios of significant main and interaction effects with grandmother's and grandfather's co-residence, and stunting as dependent variable (Model 2)

Main effects	**β**	**S.E.**	**Exp(β)**
Grandmother in household	-.052**	0.017	0.95
Grandfather in household	-.022	0.021	0.98
Interaction effects			
Grandmother * Education father	.007*	0.004	1.01
Grandfather * Sex (0=boy, 1=girl)	-.108***	0.031	0.90
Grandfather * Uncle in household	.196*	0.092	1.22
Grandfather * Household wealth	.002**	0.001	1.00
Grandfather * Polygamous household	-.153**	0.049	0.86
Grandfather * Vitamin A (in two months after delivery)	.091*	0.038	1.10
Grandfather * Size at birth (1=very large, 5=very small)	.035*	0.016	1.04

***P<0.001 **P<0.01 *P<0.05

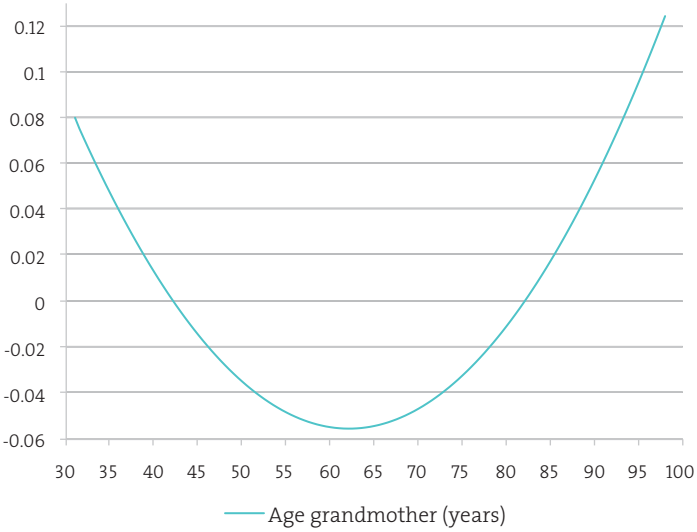
For grandfather's co-residence, I observe several significant interactions with other covariates. The difference in stunting between boys and girls, with boys being more stunted than girls, is significantly larger in households with a co-residing grandfather. This indicates that girls take more advantage of a co-residing grandfather than boys.

The presence of an uncle in the household does not have a significant effect on children's stunting. Remarkable however is the finding that the odds of being stunted increase with 22% when children are living with both their uncle and grandfather. Polygamy at household level increases the odds of being stunted, but when a grandfather is present this effect weakens substantially. The odds of being stunted in a polygamous household are reduced by 14% when the grandfather is present. Apparently grandfathers buffer young children from stunting in these households.

Children are less stunted in wealthier households, but this effect is significantly reduced if there is a grandfather in the household. This might mean that in those households, grandfathers tend to compete with their grandchildren for the available resources. Two other interactions also point into this direction. Children who are small at birth or who received a vitamin A dose in the two months after delivery tend to have a significantly higher risk of being stunted in households with a co-residing grandfather.

There are no significant interactions with cluster and district level variables. Hence the effects of co-residing grandparents on children's stunting are stable across the different contexts in which the households may live.

Figure 6.1 Grandmother's age and the log odds of being stunted (output model 2)*



* Figure based on the grandmother's age and age² variables from model 2 (table 6.2)

6.6 Conclusion and discussion

Using a newly built database consisting of 69 DHS-surveys with information on 345.026 children (171.669 girls and 173.357 boys) aged 6-60 months, I examined the relationship between the co-residence of grandparents and children's stunting in 31 SSA countries. Besides the general association between the presence of grandparents and children's stunting, I was interested in how this relationship is influenced by socio-economic, demographic and cultural characteristics at the household and context level.

I found broad evidence that children living with a grandmother in the household have lower odds of being stunted than children who are not living with their grandmother. This finding is in line with the *grandmother support hypothesis* which is based on the expectation that grandmothers who are already living in a household have a low threshold to help rearing their grandchildren. The findings also support the *classical grandmother hypothesis* which states that the healthy years a woman lives after the menopause enables her to increase her own reproductive success by investing in the reproductive success of her children (e.g. Hawkes et al., 1997; Hawkes, 2004; Lahdenperä et al., 2004). Grandmothers

are most positive for reducing the odds of being stunted when they are between 55 and 68 years of age. For young grandmothers and grandmothers who are very old, the positive effect is weaker. A possible explanation for this finding is that young grandmothers may still be caring for their own children, whereas old grandmothers may become physically dependent on their (grand)children themselves.

Concerning the role of grandfathers, I did not expect to find a straightforward connection between their co-residence and children's stunting. Traditionally, grandfathers are less involved in household work and are not familiar with caring tasks. While (grand)mothers are supposed to be focused on feeding and caring of young children, (grand)fathers might be more focused on the future achievements of their grandchildren in society. This expectation is supported by the results. There is no significant association between the presence of a grandfather in the household and children's stunting. This might be due to the fact that grandfathers are less involved in household work, caring tasks and helping their daughters (in law) with breastfeeding like grandmothers.

Given the existence of positive effects of parental education on children's stunting (Keino et al., 2014; Prendergast & Humphrey, 2014), I hypothesized to find positive effects of grandparental education as well. For co-residing grandfathers this hypothesis was indeed confirmed by the data. If they had a higher educational level, their grandchildren suffered less from stunting. However, for co-residing grandmothers the situation is different; the positive effect of their presence in the household is does not depend on their educational level.

The lack of a general (mean) effect of grandfather's co-residence on children's stunting does not rule out the possibility that grandfathers are important under specific circumstances. For example, I found evidence that co-residing grandfathers are a positive asset in polygamous households. This is an important finding, given that there is broad evidence (including the findings in this analysis) that stunting rates are higher in polygamous households (e.g. (Strassmann (2011); Omariba & Boyle (2007) Kandiyoti (1988)). Polygamy creates conflicts within families associated with asymmetries in genetic relatedness. If there is more uncertainty about genetic relatedness among family members, the risk of conflict increases. Apparently grandfathers are able to buffer young children from being stunted under these difficult circumstances.

I also expected grandfathers to become important when parents are missing or when there is no grandmother who can help their (grand)children. I thought that in such situations grandfathers might more or less be forced into a role as caregiver and become important for the well-being of their grandchildren, but these expectations were not supported by the results. When the father is missing or when there is no co-resident grandmother, the grandfather effect remains insignificant.

Higher household wealth reduces the risk of being stunted. But in combination with the presence of a grandfather in the household this effect weakens. Apparently, grandfathers attract some of household resources towards themselves. Children who are small at birth are more at risk of being stunted. The presence of a grandfather in the household enhances this effect. Empirical evidence shows that boys are more likely to be stunted than girls across multiple countries in SSA (Berendsen et al., 2016; Keino et al., 2014; Wamani, et al., 2007). The results are in line with these earlier findings. However, notable is the finding that in households with a co-resident grandfather this effect is enhanced. This indicates that girls take more advantage of a co-residing grandfather than boys. For grandmothers no such an effect was found.

The findings are interesting, but some cautiousness is required as this study suffers from some limitations. Due to the way the stunting data is collected, there are no children with a missing mother in my dataset. This might influence the outcomes, as in the absence of a mother the presence of grandparents, especially the grandmother might be more important. Another important limitation is that my analyses are based on cross-sectional data. Although important new information is obtained on the association between grandparental co-residence and children's stunting and on the way this relationship varies, no strict conclusions in terms of causal relations can be drawn. Furthermore, it was not possible to say something about the distance gradient in grandparental support. The data used in this study does not contain information on non-residing grandparents. Grandparents living near their (grand)children are probably better able to support them than grandparents living further away. Insight into the nature of this relationship is essential for policymakers and social agents who want to strengthen existing family ties in order to improve the position of children. Further research is therefore needed on this distant gradient, as well as on some other missing factors, like the presence of the mother and the role played by local organizations, like schools, governmental services and NGO's.

In general I can conclude that grandmothers plays an important role regarding the reduction of children's stunting in SSA. The effect is sizeable and is not influenced by household and context characteristics, except for grandmother's age and the educational level of the father. In contrast to this, the co-residence of a grandfather seems to play only a significant role in particular situations. Especially girls and children who are living in a polygamous household seem to profit of living with their grandfather. However, children who are living with a co-resident grandfather in a less wealthy household, where also uncles are living, or who were small at birth seem to be disadvantaged when living with a grandfather.

Chapter 7

Conclusion and Discussion

7.1 Introduction

In the introduction of this thesis I explained that a great deal of research in developing countries has focused on parents and the relationship with their children. The role of grandparents concerning the well-being of their grandchildren is a relatively underexposed area in the field of development studies. Particularly in developing countries, where extended household structures are still common practice, grandparents and especially grandmothers are supposed to play an important role in the lives of their grandchildren. Existing literature on this topic shows that their role varies. Several studies found the presence of grandparents and in particular that of the grandmother to be beneficial for their grandchildren (Hawkes et al., 1997; Hrdy, 1999; Sear et al., 2000; Sear & Mace, 2008). However, there are also scholars who found negative or null effects of grandparents on the well-being of their grandchildren (Jamison et al., 2002; Voland & Beise, 2002; Strassmann 2011). Most of these small scale studies focus on child mortality, stunting and only a few focus on schooling. Broad comparative research, focussing on both stunting and schooling and how this relationship with co-residing grandparents varies according to household and context characteristics, is lacking. This thesis attempts to fill this gap. In the preceding chapters, I analysed the effect of co-residing grandmothers and grandfathers in relation to grandchildren's stunting and schooling. By building and analysing a database of more than 30 African countries I intended to find new and broad comparative evidence regarding the role of grandparents with respect to their grandchildren's well-being in sub-Saharan Africa (SSA). By studying stunting (6-60 months) and schooling (7-15 years) much of the juvenile period of children is covered.

In sum, the aim of this thesis was to uncover the relationship between co-residing grandparents and the schooling and stunting of their grandchildren in families in SSA countries, under a broad range of circumstances. To reach this goal I aimed to answer the following research questions.

7.2 Research questions

1. What is the relationship between grandmother's co-residence and their grandchildren's schooling in sub-Saharan Africa? How is this relationship moderated by household and context characteristics?

2. To what extent and in what way does the effect of co-residing grandmothers on the schooling of their grandchildren differ between paternal and maternal grandmothers? How is this relationship moderated by household and context characteristics?

3. What is the relationship between grandfather's co-residence and their grandchildren's schooling in sub-Saharan Africa? How is this relationship moderated by household and context characteristics?

4. What is the relationship between grandmother's and grandfather's co-residence and the growth of their grandchildren (stunting) in sub-Saharan Africa? How is this relationship moderated by household and context characteristics?

To answer the first question I studied the relationship between grandmother's co-residence and children's schooling in chapter 3. The main point of departure in this chapter is that grandmothers are supposed to help, nurture and feed their grandchildren. This idea finds broad support in literature, for example in theory regarding the development of the menopause. This so called classical *'grandmother hypothesis'* assumes that the healthy years a woman lives after the menopause enables her to increase the reproductive success of her children. In this way, grandmothers can increase their own reproductive success (e.g. Hawkes et al., 1997; Hawkes, 2004; Lahdenperä et al., 2004). A second important premise is that grandmothers who are already living with their grandchildren are supposed to have a low threshold to invest in their grandchildren compared to grandmothers who are not living with their grandchildren. Co-resident grandmothers are physically present in the household and are expected to consider it as their (normal) duty to contribute to the household and child rearing. Grandmothers can compensate the opportunity costs of schooling of their grandchildren, who are not able to contribute to the household when they go to school. They can enable parents to work outside the home or prevent children, especially girls, from taking over household tasks when their mother is working (Huisman and Smits, 2009). However, grandmothers might also be a burden to the household resources. The *local resource competition hypothesis* (e.g. Borgerhoff Mulder, 2007; Sear and Mace, 2008) for example predicts that altruistic behaviour of family members

may be reduced when there is scarcity of local resources. Interaction analysis was used to study the influence of context and household characteristics.

The second question is answered by studying the relative importance of paternal versus maternal grandmothers for children's schooling in chapter 4. The relative importance of paternal versus maternal grandmothers is called the *grandmother gender effect* in this thesis. Evolutionary theory has often been used to explain grandparental investment in general and more specific the investment differences between maternal and paternal grandmothers (e.g. Bishop et al., 2009; Euler & Michalski, 2007; Laham et al., 2005). This theory predicts grandmothers to invest more in their daughters' children than in their son's children. This expectation is based on what is called the *confidence of paternity hypothesis* (Gaulin & Schlegel, 1980; Strassmann & Garrard, 2011). The idea is that grandparental investment depends on the likelihood of being genetically related to a certain grandchild. The uncertainty about genetic relatedness is smaller for maternal grandmothers than for paternal grandmothers. Mother's mother knows for certain that her daughter is her daughter and that her daughter's child is her grandchild. Father's mother is certain that her son is her son, but is less certain that her son's child is her grandchild, because the wife of her son may be unfaithful. The confidence of paternity hypothesis therefore predicts maternal grandmothers to be more willing to invest in their grandchildren than paternal grandmothers. Although this argument seems reasonable, empirical evidence does not unequivocally support it. This chapter (4) tries to gain more insight into this relationship as well as how it varies according to specific circumstances.

To answer the third question, I analysed the relationship between grandfather's co-residence and children's schooling in chapter 5. Starting point in this chapter is a theoretical framework for studying and understanding the role of grandfathers, using the work of Bates (2009). At the heart of his theory of g*enerative grandfathering* is the developmental stage of 'generativity', introduced by Erikson (1963) as one of the eight stages in psychosocial development. In the *generative* stage of life (ages 40-64), establishing and guiding the next generation forms a central theme. Grandfathering and generativity are connected through the generative work of grandfathers, which can be described as the efforts grandfathers put forth when nurturing and caring for their offspring. While (grand)mothers are supposed to be focused on feeding and taking care of young children, (grand) fathers are expected to be more focused on the societal position of their grandchildren. In their capacity as a mentor and teacher, grandfathers can teach about interpersonal relationships and transfer values to their grandchildren. Next to generativity the expectation is that grandfathers who are already living with their grandchildren are supposed to have a low threshold to invest in their grandchildren compared to grandfathers who are not living with their grandchildren.

In chapter 6 the last question is answered by analysing the role of grand- mothers and grandfathers related to the growth (stunting) of their grandchildren. Regarding the grandmother I found her presence in the household to be associated with lower stunting rates of her grandchildren. Grandmothers are physically present in the household, are experienced in raising offspring and can advise and support them. This is particularly useful when their daughter(-in-law) is young and has to take care of multiple children. Malnutrition and infections in the first years after birth are important triggers for growth retardation. Breastfeeding and complementary feeding, maternal nutrition during pregnancy, vaccinations and vitamin supplements may reduce the risk of stunting (Alemayehu et al., 2015; Berendsen et al., 2016; Bhutta et al., 2008; Keino et al., 2014). Grandmothers who co-reside with their children (and grandchildren) have better opportunities to positively influence the aforementioned factors than grandmothers living elsewhere.

Traditionally, grandfathers are less involved in household work and are not familiar with caring tasks and breastfeeding, like grandmothers. I therefore did not expect to find a straightforward connection between the presence of a grandfather in the household and children's stunting. While (grand)mothers are supposed to be focused on feeding and caring of young children, (grand)fathers might be more focused on the future achievements of their grandchildren in society. As a mentor they can teach their grandchildren and offer them wisdom and life experience as explained in chapter 5 (Waldrop et al., 1999). However, grandfathers might become important for young children under certain conditions. For example when parents are missing or when there is no grandmother who can help their (grand)children. In such situations grandfathers might more or less be forced into a role as caregiver and become important for the well-being of their grandchildren

The results of my analysis are brought together in Table 7.1. Differences in the strength of the main effect of co-residing grandparents between boys and girls are indicated by a double sign. In the remainder of this chapter I will draw conclusions regarding each research question.

7.3 Results

7.3.1 Research Question 1: Grandmothers and children's schooling

What is the relationship between grandmother's co-residence and their grandchildren's schooling in sub-Saharan Africa? How is this relationship moderated by household and context characteristics?

Table 7.1 Significant results co-residence grandparents and the schooling & stunting of their grandchildren

	Schooling						Stunting	
	Chapter 3		**Chapter 4**		**Chapter 5**		**Chapter 6**	
Co-residence grandparents	boys	girls	boys	girls	boys	girls	boys	girls
Co-residence grandmother	+	++					-	-
Co-residence paternal grandmother†			++	o				
Co-residence grandfather					+	++	o	o
Characteristics grandparents								
Education grandmother	o		+		+		o	
Age grandmother	+		+		+		-	
Age grandmother square	-				-		+	
Education grandfather					+		-	
Age grandfather					+		o	
Interactions with grandmother (Gm)								
Gm * Sex (o=boy, 1=girl)	+						o	
Gm * Mother alive, not in household	+						o	
Gm * Mother dead	+						o	
Gm * Number of sisters	-						o	
Gm * Education fathers	o						+	
Gm * Occupation father (lower non-farm)	-						o	
Gm * Educational level (cluster)	+						o	
Gm * Level of development (district)	+						o	
Gm * Relative position women	-						o	
Gm * Living in rural area	+						o	
Gm * Co-residence grandfather	-						o	
Interactions with paternal grandmother†								
Gm gender * Sex (o=boy, 1=girl)			-					
Gm gender * Education mother			-					
Gm gender * Education father			+					
Gm gender * Co-residence grandfather			+					
Interactions with grandfather (Gf)								
Gf * Age child					+		o	
Gf * Sex (o=boy, 1=girl)					+		-	
Gf * Mother alive, not in household					+		o	
Gf * Mother dead					+		o	
Gf * Relative position women					-		o	
Gf * Co-residence grandmother					-		o	

Table 7.1 Continued

	Schooling						Stunting	
	Chapter 3		**Chapter 4**		**Chapter 5**		**Chapter 6**	
Interactions with grandfather (Gf)	boys	girls	boys	girls	boys	girls	boys	girls
Gf * Age grandmother					+		o	
Gf * Uncle in household					o		+	
Gf * Household wealth					o		+	
Gf * Polygamous household					o		-	
Gf * Vitamin A (in two months after delivery							+	
Gf * Size at birth (1=very large, 5=very small)							+	

Positive/negative sign represents significant higher/lower likelihood of being in school/stunted. A double sign represents a stronger effect. Focal points of different chapters are outlined in **bold**. Insignificant effects are marked by a 'o'. † Grandmother gender effect (effect of paternal relative to maternal grandmother).

To answer this question I studied the relationship between grandmother's co-residence and children's schooling in chapter 3. I found that the presence of a grandmother in the household is a positive resource under a broad range of circumstances within the SSA context. Children living in a household with a co-residing grandmother are more likely to be in school than children living without a co-residing grandmother. Girls profit more from a co-residing grandmother than boys, which might indicate that grandmothers take over household tasks that otherwise would have been done by girls.

However, the grandmother effect is not the same in all situations. The effectiveness of grandmothers is non-linearly related to their age. Grandmothers aged between 65 and 75 seem to be most effective in helping their (grand) children. Their contribution also varies according to specific resource- and gender-related factors at the household and context level. Grandmothers are especially important when the mother is dead or missing in the household, but this is hardly the case when the father is absent or death. Hence grandmothers may replace a missing mother, but less so a missing father. Interestingly, a co-residing grandmother is particularly good for children's schooling when the household is situated in a more developed (wealthier) environment or in a community with a more highly educated population. It thus seems that grandmothers help the family to make better use of favourable circumstances. This finding is in line with the local resource competition hypothesis, which predicts altruistic behaviour of family members to be reduced when there is scarcity of local resources (and thus enhanced under more favourable circumstances).

There are no significant interactions with wealth or education at the household level and with the work status of the mother. Hence, poor and uneducated households profit as much from a co-residing grandmother as wealthier and educated households. Although one would expect the grandmother to be more important when the mother has a job, the effect is not influenced by the work status of the mother. Occupation of the father on the other hand does make a difference. Grandmothers are more important when the father is employed in a farm job instead of a lower non-farm job. A possible explanation may be that most of the grandmothers in the data grew up in rural areas, often at farms. This means that they are probably more familiar with life in the countryside -- and can contribute more to the household there -- than in an urban environment. This explanation is further supported by the finding that grandmothers are less effective when the household is located in an urban environment.

Grandmothers are equally important for children at the primary and the lower secondary school level. In households where the position of the mother is stronger and in households with more (grand) daughters, a co-residing grandmother makes less of a difference. If mothers have a stronger bargaining power, or if household tasks can be divided among more daughters, there might be less need for a grandmother to contribute to the household. Given the negative effects of polygamy on child survival documented in earlier research (e.g. Omariba & Boyle, 2007; Strassmann, 2011), the question was raised whether the grandmother effect concerning children's schooling would be affected by polygamy, at the household or at the community level. This turned out not to be the case. The contribution of a grandmother in these households does not differ from that in other households.

In sum, I found evidence in favour of the existence of a positive grandmother effect. Across a broad range of circumstances in the SSA context the co-residence of a grandmother is positively associated with children's schooling.

7.3.2 Research Question 2: Paternal versus maternal grandmothers

To what extent and in what way does the effect of co-residing grandmothers on the schooling of their grandchildren differ between paternal and maternal grandmothers? How is this relationship moderated by household and context characteristics?

To answer this question I analysed the relative importance of paternal versus maternal grandmothers in relation to children's schooling in chapter 4. I found that children living with their paternal grandmother have better schooling outcomes relative to those who are living with their maternal grandmother. This is a remarkable finding. According to the *confidence of paternity hypothesis* grandmothers are supposed to invest more in their daughters than in their sons,

because they are more certain about their genetic relatedness to the children of their daughters. The effect of the paternal grandmother relative to that of the maternal grandmother (*grandmother gender effect*) is more or less doubled by presence of a grandfather. Given that in almost all these cases the grandfather is the husband of the grandmother, this indicates that grandfathers have an equally strong tendency as grandmothers to invest more in the children of their sons than in the children of their daughters. The grandmother gender effect is particularly strong for boys. This implies that grandmothers not only invest more in their son's children than in their daughter's children, but also that they invest more in their son's sons than in their son's daughters. A possible explanation for this finding is Africa's culture of male dominance. Many regions of Africa are characterized by a culture in which men, sons and grandsons are considered more important than women, daughters and granddaughters (Giovarelli et al., 2013; Jütting et al., 2008; Kandiyoti, 1988).The preference for sons over daughters in these cultures is so strong that grandmothers tend to favour their son's children over their daughters children even though the genetic relatedness of their son's children is less certain.

My analysis in chapter 4 further revealed that the grandmother gender effect also depends on the educational level of the parents. Father's education strengthens the grandmother gender effect and mother's education weakens this effect. This means that the tendency of grandmothers to invest in the children of their sons or their daughters is also influenced by the resources in the form of human capital those sons and daughters have at their disposal. If their sons are better educated their investments go more into the direction of their son's children and if their daughters have had more years of education they invest relatively more in their daughter's children.

No significant interaction was found between the grandmother gender effect and household wealth. This suggests that the effect does not depend on the financial resources of the household.

7.3.3 Research Question 3: Grandfathers and children's schooling

What is the relationship between grandfather's co-residence and their grandchildren's schooling in sub-Saharan Africa? How is this relationship moderated by household and context characteristics?

In chapter 5 I analyzed the relation between grandfathers and children's schooling. I conclude that children living with their grandfather are more likely to be in school than children who are not living with their grandfather. Girls profit more from a co-residing grandfather than boys. This might indicate that besides grandmothers, grandfathers also take over (household)tasks that otherwise would have been done by girls. It might also have to do with the overall weaker

position of girls compared to boys in African households, which implies that for girls more improvement is possible than for boys and that additional resources (in this case the support given by the grandfather) might benefit them more.

The level of education of co-residing grandfathers is positively associated with children's schooling. This finding seems to confirm my expectation that the quality of the m*entoring work* grandfathers put forth to teach, instruct and coach their grandchildren depends on their own knowledge. Different from grandmother's age, for which I found a parabolic effect, grandfather's age effect is linear. Grandchildren are more likely to go to school when their co-residing grandfather is older.

Next to the educational level and age of the grandfather, several other factors influence the association between co-residing grandfathers and their grandchildren's schooling. The presence of a grandfather is more positive for the schooling of older grandchildren. This finding supports the idea that grandfathers have an incentive to keep their grandchildren in school and to help them to move on from primary to secondary education. A possible explanation for their behavior is that this might add to the level of respect they gain in their environment when their grandchildren obtain a substantial level of schooling.

The presence of a grandfather for children's schooling is more important when the mother is dead or missing from the household and for children living with an older grandmother. The absence or death of the father makes no difference. This might be due to the fact that African mothers are more important for children's schooling than African fathers. The effect of a missing mother on African children's schooling is much stronger than that of a missing father (e.g. Case & Ardington, 2006; Evans & Miguel, 2007; Lloyd & Blanc, 1996; Parker & Short, 2009). Households with a missing mother therefore might be more in need of a helping grandfather than households with a missing father.

My idea that grandfathers might be more important under more difficult circumstances or in situations of scarcity could not be confirmed. Interactions with the variable polygamy had no significant effect, neither at household level, nor at community level. Regarding the strength of the relative position of fathers versus mothers in the household, I found that in the rather unusual situation that the mother of the child is older than the father, having a co-residing grandfather is less important for children's schooling. Hence a weak position of the father seems to go together with a weaker position of the grandfather.

In sum, I found evidence in this thesis in favour of the existence of a positive grandfather effect concerning children's schooling across a broad range of circumstances in the SSA context. The effect is particularly strong for older children, for girls and for older grandfathers.

7.3.4 Research Question 4: Grandparents and children's stunting

What is the relationship between grandparental co-residence and the growth of their grandchildren (stunting) in sub-Saharan Africa? How is this relationship moderated by household and context characteristics?

To answer this question I analysed the association between grandparents and the growth of their grandchildren in chapter 6. I found broad evidence that children living with a grandmother in the household are associated with lower odds of being stunted compared to children who are not living with their grandmother. Grandmothers are most positive for reducing the odds of being stunted when they are between 55 and 68 years of age.

The finding in the literature that children from better educated parents are less stunted (Keino et al., 2014; Prendergast & Humphrey, 2014) is supported by the findings in chapter 6. However, I found no such a relationship for the educational level of a co-residing grandmother. Interestingly, the presence of a grandmother is more important when fathers are lower educated.

With regard to the role of grandfathers I did not expect to find a straightforward connection between the co-residence of grandfathers and children's stunting. Grandfathers are expected to be less involved in household work, caring tasks and rearing their young offspring like grandmothers. The results confirm my expectation. On average the presence of a grandfather in the household is not significantly related to children's stunting.

However, I did find evidence that grandfathers become important for young children under certain conditions. For example the findings that higher educated grandfathers and the presence of a grandfather in polygamous households significantly reduce children's stunting. According to the literature stunting rates are higher in polygamous households (Strassmann, 2011; Omariba & Boyle, 2007, Kandiyoti, 1988). Polygamy creates conflicts within families associated with asymmetries in genetic relatedness. If there is more uncertainty about genetic relatedness among family members, the risk of conflict increases. Apparently grandfathers are able to buffer young children from being stunted under these difficult circumstances.

Certain conditions enhance the likelihood of being stunted when living with a grandfather. Higher household wealth for example reduces the risk of being stunted. But in combination with the presence of a grandfather in the household this effect weakens. This might be caused by grandfathers that attract some of the household resources towards themselves. Children who are small at birth are more at risk of being stunted. The presence of a grandfather in the household strengthens this effect. Living together with an uncle does not influence the odds of being stunted. However, living together with a grandfather and an uncle

increases the odds of being stunted. When fathers are missing or when there is not a co-resident grandmother present who can help their (grand)children, the presence of a grandfather makes no difference.

Earlier research shows that boys are more likely to be stunted than girls across multiple countries in SSA (Berendsen et al., 2016; Keino et al., 2014; Wamani, et al., 2007). The results in this thesis confirm these earlier findings. However, notable is the finding that in households with a co-resident grandfather the likelihood of being stunted is higher for boys than for girls. This indicates that girls take more advantage of a co-residing grandfather than boys. For grandmothers I found no such an effect.

In sum I can conclude that grandmothers play an important role regarding the reduction of children's stunting in SSA. The effect is sizeable and is not influenced by household and context characteristics, except for the educational level of the father. In contrast to the grandmother, the results indicate that the co-residence of a grandfather only plays a significant role regarding their grandchildren's stunting in particular situations. For example in polygamous households, where the presence of a grandfather seems to reduce children's odds of being stunted. Furthermore, especially girls seem to profit of living with their grandfather. Children who are living with a co-resident grandfather in a less wealthy household or together with their uncle or who were small at birth seem to be in the disadvantage of living with a grandfather. The grandmother effect is not influenced by the presence of a grandfather and vice versa.

7.4 Co-residence grandparents and children's well-being (stunting and schooling)

In this thesis stunting and schooling are used to analyze the role of grandparents with respect to the well-being of their grandchildren. Stunting and schooling are prevalent factors in different stages of life and together cover much of the juvenile period of children. First, the period when children are under the age of five, when they are vulnerable to growth retardation. Second, the period when children are expected to go to school, which starts around the age of six.

Based on the results in this thesis I conclude that in general grandmothers are a positive resource with regard to the well-being of their grandchildren under a broad range of circumstances. Some of the context factors studied strengthen the relationship and only a few factors slightly weaken the effect. Considering the grandfather I conclude that this association is less straightforward. The presence of a grandfather is positively related to the well-being of children at a later age when they go to school. When they are young the connection is less clear. Only in

case of polygamous households and for young girls, grandfathers seem to play an important role in preventing children from stunting. However, living together with a grandfather, and an uncle, in a poor household or as a child small at birth, seems to be detrimental for the growth of young children.

Concerning schooling grandfathers and grandmothers are to a certain extent substitutes of each other. Either of them can take over household tasks or may contribute in other ways that increase the possibilities of children to go to school. However, when the grandfather and grandmother are together in the household, the individual contribution of both of them decreases. In that situation, the grandfather effect even becomes negative. This suggests that grandfathers tend to lean to a certain extent on their wife and that grandmothers may have less energy left for their grandchildren if their husband is also present. However, this also depends on grandmother's age, as the importance of grandfathers for children's schooling increases significantly if the grandmother is older. So African grandfathers and grandmothers supplement each other to a certain extent. With respect to stunting no significant interaction between grandmothers and grandfathers was found.

Regarding schooling, girls profit more than boys of the presence of a grandmother or a grandfather in the household. Concerning stunting both boys and girls profit of the presence of a grandmother in the household, whereas only girls benefit of the presence of a grandfather. Therefore I conclude that girls seem to profit more from living with their grandparents than boys. This might have to do with the overall weaker position of girls compared to boys in African households, which implies that for girls more improvement is possible than for boys and that additional resources are more directed towards girls.

7.5 Contributions to the existing literature

Compared to earlier research this study is a major step forward, as it provides - for the first time - a broad comparative analysis of the role played by context factors for the relationship between grandparent's co-residence and child well-being and in particular children's stunting and schooling. This study is the first to setup a theoretical framework regarding the role of grandfathers in developing countries. It is also the first study to document a positive association between the presence of a grandfather and the well-being of children in SSA, in particular concerning schooling and stunting (only for girls). Earlier studies for this region did not find any grandfather effect, neither on young children's survival chances (Borgerhoff Mulder, 2007; Gibson & Mace, 2005; Sear et al., 2000; Sear, 2008) nor on children's schooling (Parker & Short, 2009). This might have to do with the relatively small

scale of these studies, the focus on very young children or the fact that those studies did not control for all relevant socio-demographic factors. The fact that the grandfather effect is substantially weaker than the grandmother effect probably also plays a role. A large database with almost a million children and a powerful design were needed to make it visible against the background of confounding factors.

This study is also the first investigating the interaction between grandmothers and grandfathers with respect to their grandchildren's stunting and schooling. Regarding schooling grandfathers and grandmothers are to a certain extent substitutes of each other. Each of them can take over household tasks or may contribute in other ways to the opportunity that their grandchildren go to school. However, when the grandfather and grandmother are together in the household, the individual contribution of each of them to children's schooling decreases. With respect to stunting I did not find such an association.

With the finding of a positive relationship between the presence of post-reproductive helpers, like grandmothers, and the well-being of their grandchildren also new evidence is found in favour of the classical grandmother hypothesis. According to this hypothesis the prolonged survival of women after their fertile ages has developed during human evolution, because it offers them the possibility to increase their own reproductive success by helping their daughters (in law) in raising their children (Hamilton, 1964; Hawkes et al., 1997; Hawkes, 2004). But what about grandfathers? What are their strategies to enhance their reproductive success? Is there such a thing as a classical grandfather hypothesis? These are important questions that have to be answered and hopefully the results of this thesis will unlock a discussion about the role of grandfathers in developing countries. For example the finding that the presence of a grandfather in the household reduces the odds of being stunted in polygamous households. Or the finding that grandfathers are important in reducing stunting when parents are missing or when there is no grandmother who can help their (grand)children.

Another interesting contribution is the finding that the presence of a grandfather is more positive for the schooling of older grandchildren. It supports the idea that grandfathers might be particularly focused on the societal position of their grandchildren, because the level of respect they gain in society may depend to a substantial degree on the level of schooling their grandchildren obtain. Therefore grandfathers have an incentive to keep their children in school and to help them to move on from primary to secondary education.

The analysis in this thesis did not provide any support for the *confidence of paternity hypothesis* which assumes uncertainty about genetic relatedness to be smaller for maternal grandmothers than for paternal grandmothers. Maternal grandmothers are therefore expected to invest more in their daughter's than in

their son's (children). In fact the opposite effect was observed. Children living with their paternal grandmother have better schooling outcomes relative to those who are living with their maternal grandmother. This means that, at least for the relationship between grandmothers and the schooling of her grandchildren, I have to reject this hypothesis.

7.6 Policy recommendations

Schooling and stunting are important factors related to economic development. Schooling can be seen as an activity that influences future benefits through the imbedding of resources in people (human capital) which is crucial for economic development (Becker 1962) and is generally seen as an important determinant of the opportunities children have in later life. A high level of stunting is considered detrimental for economic development and productivity as it is associated with poorer cognitive, educational and health outcomes (Crookston et al., 2011; Hoddinott et al., 2013; Hoddinott et al., 2008; Martorell et al., 2010; Pradhan et. al., 2003; Wamani et. al., 2007; WHO, 1995). The central aim of this thesis was to increase our understanding of the way in which schooling and stunting of children in SSA is influenced by co-residing grandparents living in different households and contexts. My results have important implications for policy makers who want to improve educational participation and reduce stunting in the region. First of all, the findings make clear that children, parents, grandparents and other relatives do not live in isolation from each other and their environment. It is therefore important to study these facets simultaneously and for policymakers to recognize these interrelationships when designing policies to enhance the schooling opportunities of children and policies to reduce children's stunting.

Second, the findings make clear that co-residing grandparents and in particular grandmothers play an important role concerning their grandchildren's schooling and stunting. Their importance varies according to characteristics of the household and the environment grandparents and grandchildren are living in. When designing policies aimed at strengthening the position of children and economic development in the SSA context, it is therefore important that grandmothers as well as grandfathers are not overlooked. Especially when mothers die, grandmothers are usually the ones that take over the care for their grandchildren. This might be due to the fact that African mothers are more important for children's schooling than African fathers. The effect of a missing mother on African children's schooling is much stronger than that of a missing father (e.g. Case & Ardington, 2006; Evans & Miguel, 2007; Lloyd & Blanc, 1996; Parker & Short, 2009).

Third, my analyses also show that although the effect of a co-residing grandmother is stronger than that of a co-residing grandfather, there are situations in which a grandfather may play an important role as well. This is especially the case when there is no grandmother in the household, in polygamous households, when the mother is absent or dead and when the grandfather is more highly educated. Co-residence of a grandfather is also more important for girls than for boys and for older (secondary school aged) children. Findings indicate that grandmothers and grandfathers may strengthen each other's positive effects (e.g. they are both important for girls and when the mother is absent or dead), but that they also are to a certain extent substitutes for each other (they are more important if they are the sole co-residing grandparent). Hence, either of them can contribute to the household in ways that increase the possibilities of children to go to school.

Many African communities are characterized by a culture of male dominance, in which men are considered more important than women. (Giovarelli et al., 2013; Jütting et al., 2008; Kandiyoti, 1988). Poor access to health care and poor ownership and inheritance rights for women places grandmothers in a difficult position. (Cooper, 2012; International African Institute, 1950; Richardson, 2004; Unicef, 2007). However, that does not mean that grandmothers are powerless. As our findings in chapter 4 show, particularly grandmothers from fathers side have much possibilities to increase their grandchildren's chances to go to school and may strengthen the position of mothers with little education in this respect. Given the importance of grandmothers for children's schooling and preventing stunting, policymakers should not only focus on improving the financial position of (elder) women, but they should also focus on improving their rights.

Finally, policies aimed at reducing stunting should take notice of the role of grandfathers in polygamous households. Co-residing grandfathers are a positive asset in polygamous households. This is an important finding, given that there is evidence (including the findings in this thesis) that stunting rates are higher in polygamous households (e.g. (Strassmann (2011); Omariba & Boyle (2007) Kandiyoti (1988)). Polygamy creates conflicts within families associated with asymmetries in genetic relatedness. If there is more uncertainty about genetic relatedness among family members, the risk of conflict increases. Apparently grandfathers are able to buffer young children from being stunted under these difficult circumstances.

One of the few organizations who is actively supporting grandmothers in Africa is the Stephen Lewis Foundation. Through grass root organizations in the Eastern part of Africa they provide (financial) support for grandmothers who take care of their orphaned grandchildren. My analysis show that this support should not only be restricted to the Eastern part of Africa but to the whole SSA continent.

It also shows that policies aimed at improving the schooling of children should not only focus on the grandmother, but also grandfathers have to be taken into account.

7.7 Discussion and suggestions for further research

Some caution is required regarding the conclusions, as this study has some limitations. First, it is based on cross-sectional data. This implies that although important new information is obtained on the association between grandparent's co-residence and children's well-being and on the variation of this relationship across circumstances, no strict conclusions in terms of causal relations can be drawn.

Second, our data does not contain information on non-residing grandparents. Grandparents living near their (grand)children are probably better able to support them than grandparents living farther away. Insight into the nature of this relationship is essential for policymakers and social agents who want to strengthen existing family ties in order to improve the position of children. Further research is therefore needed on this distant gradient, as well as on some other missing factors, like the role played by local organizations, schools, governmental services and NGO's.

Third, there are no children with a missing mother in the dataset used for the stunting analysis. This might influence the outcome of this analysis. In the absence of a mother the presence of grandparents, especially the grandmother might be more important. In case of a missing mother and a missing grandmother the presence of a grandfather might become more important.

In this study evidence is found that regarding schooling grandfathers and grandmothers are to a certain extent substitutes of each other. Each of them can take over household tasks or may in other ways contribute to the opportunities that their grandchildren go to school. More research into the nature of this relationship is needed to assess the precise nature of this interplay between grandmothers and grandfathers, which apparently influences their individual contribution to the household.

Further research is also needed regarding the role of grandfathers. Compared to the extensive literature on the classical grandmother hypothesis, very little is known about the role and (evolution of) the reproductive strategies of grandfathers. Is there such a thing as a '*classical grandfather hypothesis*'? I found strong evidence that the presence of a grandfather in the household reduces the odds of being stunted in polygamous households. I also found that grandfathers are important in reducing stunting when parents are missing or when there is no grandmother

who can help their (grand)children. How must we interpret these findings? What is exactly the role of grandfathers in these situations? And how is it related to their reproductive strategy? I hope my findings will inspire other researchers to focus more on the role of grandfathers.

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Summary in Dutch
Samenvatting

Inleiding

Onderzoek naar het welzijn van kinderen in ontwikkelingslanden richt zich in belangrijke mate op de rol van ouders en vooral die van moeders. De rol van oma's en opa's in het huishouden is een relatief onderbelicht onderwerp. Dit is een interessant gegeven, gezien het feit dat het aandeel ouderen van boven de 60 jaar in de wereldbevolking naar verwachting zal stijgen van 12% nu tot 21% in 2050. Een groot en groeiend deel van deze ouderen woont in ontwikkelingslanden. Dit aandeel is momenteel al 60% en in 2050 naar verwachting zelfs 80%. Daarnaast stijgt de levensverwachting, waardoor generaties langer samenleven en waarschijnlijk ook meer contact met elkaar zullen hebben.

Intergenerationele contacten zijn zowel voor (klein)kinderen als voor de grootouders zelf van belang. Omdat in ontwikkelingslanden meestal een goed pensioenstelsel ontbreekt, vormen (klein)kinderen vaak een belangrijke pensioenvoorziening voor ouderen. Daarnaast kan het contact met (klein)kinderen bijdragen aan het emotioneel welzijn van grootouders. Zij kunnen voldoening halen uit het bieden van ondersteuning aan hun kinderen en kleinkinderen. Omgekeerd kunnen (klein)kinderen op hun beurt profiteren van de ondersteuning die zij van hun grootouders ontvangen.

Die ondersteuning is extra belangrijk voor kinderen die leven onder moeilijke omstandigheden, zoals in ontwikkelingslanden vaak het geval. In Afrika zorgt zo'n 40% van de oma's en opa's tussen 40 en 85 jaar regelmatig voor hun kleinkinderen. Dit komt mede door de Aids epidemie waardoor in veel gezinnen één of beide ouders zijn weggevallen. Daarnaast komen in ontwikkelingslanden traditioneel veel huishoudens met drie generaties voor. Vanwege de veelal sterke band tussen moeders en dochters wordt vooral aan oma's een belangrijke rol toegedicht. Hun ervaring met zorg en opvoeding komt goed van pas als de kleinkinderen jong zijn en hun moeder de zorg voor de kinderen moet combineren met andere huishoudelijke taken en werkzaamheden buitenshuis.

Dat grootmoeders een belangrijke positieve bijdrage kunnen leveren aan het welzijn van hun kleinkinderen betekent echter nog niet dat dat ook altijd het geval is. Recent onderzoek laat zien dat er ook situaties zijn waarin hun rol veel minder positief is. Zo blijken bij de Dogon in Mali jonge meisjes in huishoudens met een inwonende grootmoeder vaker een groeiachterstand te hebben vanwege het zware werk dat zij op het land moeten verrichtten voor hun oma. Als de oma zo oud is dat ze geen bijdrage meer kan leveren aan het huishouden en zorg nodig heeft, kan haar aanwezigheid bovendien de sterftekans van haar dochters verhogen. In de door armoede gekenmerkte samenleving van de Dogon, worden grootmoeders een last voor het huishouden en concurrent van hun kleinkinderen.

Bijdrage Proefschrift

In dit proefschrift breng ik in kaart welke rol oma's en opa's spelen als het gaat om het welzijn van kinderen in sub Sahara Afrika. Hiervoor analyseer ik de rol van grootouders in relatie tot de onderwijsdeelname en de groei van hun kleinkinderen in de eerste levensjaren. Bestaand onderzoek naar het welzijn van kinderen in ontwikkelingslanden richt zich in belangrijke mate op de rol van ouders en voornamelijk op die van moeders. De rol van oma's en opa's in het huishouden is een relatief onderbelicht onderwerp. Bovendien richten de meeste onderzoeken zich op een beperkt gebied of op slechts één land. Breed vergelijkend onderzoek over meerdere landen en gebieden in Afrika ontbreekt. Met dit proefschrift wil ik daar verandering in brengen.

Door een groot aantal landen tegelijkertijd in de analyse te betrekken, kan de invloed van omgevingsfactoren op de relatie tussen grootouders en het welzijn van kinderen beter bestudeerd worden. Het gaat daarbij bijvoorbeeld om factoren op het niveau van het huishouden zoals het aantal broers en zussen, het opleidingsniveau van de ouders of het verschil in leeftijd tussen ouders. Maar ook om factoren op regionaal niveau, zoals bijvoorbeeld het welvaartsniveau, de mate waarin polygamie voorkomt en of het huishouden zich in stedelijk gebied of op het platteland bevindt.

Mijn onderzoek draagt op verschillende manieren bij aan de literatuur. Op de eerste plaats worden meer dan in eerder onderzoek de relevante factoren op huishoudens- en contextniveau samengenomen in de analyse. Hierdoor wordt inzicht verkregen in de unieke bijdrage van iedere factor afzonderlijk. Op de tweede plaats maak ik gebruik van een groot databestand, dat bijna alle landen van sub Sahara Afrika omvat. Ik combineer 69 grote databestanden voor ruim 30 Afrikaanse landen, waardoor ik een Big Data infrastructuur voor de regio heb opgebouwd. Naast veel gegevens op huishoudensniveau bevat dit databestand ook veel informatie over de omgeving waarin de huishoudens zich bevinden. Hierdoor was het mogelijk de rol van de omgeving van huishoudens veel gedetailleerder te onderzoeken dan in eerder onderzoek. Op de derde plaats betrek ik naast gegevens van de grootmoeder ook gegevens van de grootvader in de analyse. Hierdoor wordt voor het eerst inzicht verkregen in hoe de aanwezigheid van Afrikaanse oma's en opa's in onderlinge samenhang het welzijn van hun kleinkinderen beïnvloedt. Op de vierde plaats draagt mijn onderzoek bij aan de literatuur door het belang van Afrikaanse grootouders voor de schooldeelname van hun kleinkinderen te onderzoeken. Opleiding is een belangrijke factor als het gaat om economische groei en het vormt een goede indicator voor het welzijn van kinderen op latere leeftijd. Over de relatie tussen grootouders en schooldeelname was nog weinig bekend. Tot slot levert mijn onderzoek een belangrijke bijdrage

aan de literatuur door naast schooldeelname ook het belang van grootouders voor de lichaamsgroei van het kleinkind in de eerste vijf levensjaren te onderzoeken. Met de combinatie van lichaamsgroei en schooldeelname dekt dit proefschrift een groter deel van de ontwikkelingsperiode van kinderen dan in eerdere studies het geval was.

Data

Voor deze studie zijn 69 'Demografic and Health Surveys' (DHS) die sinds 2000 zijn gehouden in de landen van sub Sahara Afrika gecombineerd (www.dhsprogram.com). DHS zijn grote, nationaal representatieve enquêtes op huishoudniveau. Voor elke enquête worden niet-overlappende gebieden willekeurig geselecteerd. Deze gebieden zijn meestal gemeenschappen, dorpen of stadswijken. In de geselecteerde gebieden wordt een steekproef van 25-30 huishoudens genomen. In de enquête wordt basisinformatie verzameld van alle leden van het huishouden. Vrouwen en mannen in de leeftijd van 15 tot 49 jaar worden geïnterviewd. In deze interviews wordt informatie verzameld over sociaal-economische, demografische en gezondheidsgerelateerde factoren.

Model en onderzoeksvragen

Het onderzoek in dit proefschrift richt zich op oma's en opa's in sub Sahara Afrika en de rol die zij spelen bij het welzijn van hun kleinkinderen. Ik vergelijk het welzijn van kinderen die met én kinderen die zonder hun oma en/of opa samenwonen. Wat betreft het welzijn van kinderen maak ik gebruik van twee indicatoren: groeiachterstand in de leeftijd van 6-60 maanden en schooldeelname van kinderen van 7-15 jaar. Omdat bestaande onderzoeken zowel positieve als negatieve effecten van de aanwezigheid van grootouders rapporteren, onderzoek ik tevens hoe en welke omgevingsfactoren deze relatie beïnvloeden. Het meeste onderzoek richt zich op de rol van oma's. Ik heb er daarom voor gekozen in de eerste plaats de rol van oma's te bestuderen. Mijn eerste onderzoeksvraag luidt dan ook als volgt:

1. Wat is de relatie tussen de aanwezigheid van een grootmoeder in het huishouden en de schooldeelname van haar kleinkinderen? En hoe wordt deze relatie beïnvloed door de huishoudkenmerken en omgeving waarin het huishouden zich begeeft?

Theorieën uit de evolutionaire biologie wijzen er op dat onzekerheid bij grootmoeders over verwantschap met het nageslacht kan leiden tot een verschil in betrokkenheid tussen oma's van moederskant en oma's van vaderskant. Moedersmoeder weet 100% zeker dat haar dochter haar genen draagt. Hetzelfde geldt voor de kinderen van haar dochter, haar kleinkinderen. Voor vadersmoeder ligt dat anders. Hoewel zij ook zeker weet dat haar zoon haar genen draagt, is ze niet 100% zeker dat haar zoon ook echt de vader is van haar kleinkinderen. Mijn tweede onderzoeksvraag is daarom als volgt geformuleerd:

2. In hoeverre en op welke wijze verschilt het effect van de aanwezigheid van een oma in het huishouden op het naar school gaan van haar kleinkinderen tussen oma's van moeders en oma's van vaders kant? En hoe wordt deze relatie beïnvloed door de huishoudkenmerken en omgeving waarin het huishouden zich begeeft?

In mijn derde en vierde onderzoeksvraag richt ik me ook op de rol van opa's:

3. Wat is de relatie tussen de aanwezigheid van een grootvader in het huishouden en het naar school gaan van zijn kleinkinderen? En hoe wordt deze relatie beïnvloed door de huishoudkenmerken en omgeving waarin het huishouden zich begeeft?

4. Wat is de relatie tussen de aanwezigheid van oma's en opa's in het huishouden en de groei van hun kleinkinderen? En hoe wordt deze relatie beïnvloed door de huishoudkenmerken en omgeving waarin het huishouden zich begeeft?

Voor het opstellen van mijn hypothesen heb ik een theoretisch model geconstrueerd op basis van literatuur uit verschillende disciplines, waaronder de economie, evolutionaire biologie, antropologie en sociologie. Een belangrijke aanname is dat ik er vanuit ga dat oma's en opa's die samenwonen met hun kleinkinderen meer bereid zijn te investeren in hun kleinkinderen dan grootouders die niet samenwonen met hun kleinkinderen. De veronderstelling is dat grootouders die samenwonen met hun kleinkinderen meer betrokken zijn en gemakkelijker huishoudtaken kunnen overnemen en zorg kunnen verlenen. Dit geldt vooral voor grootmoeders. Grootvaders worden geacht een belangrijkere rol te spelen als kleinkinderen wat ouder zijn en naar school gaan. Daarnaast is de veronderstelling dat de rol van grootouders afhangt van onder meer de beschikbaarheid van hulpbronnen en gender gerelateerde factoren. Wat betreft hulpbronnen gaat het bijvoorbeeld om het opleidingsniveau van ouders en grootouders of het al dan niet aanwezig zijn van ouders en het opleidings- en welvaartsniveau in de regio.

Wat betreft gender gaat het bijvoorbeeld om de positie van vrouwen en het verschil tussen jongens en meisjes.

Indeling Proefschrift

Mijn proefschrift is opgebouwd als volgt. In hoofdstuk 1 geef ik een inleiding op het onderwerp grootouders in ontwikkelingslanden. Daarnaast beschrijf ik het belang van schooldeelname van kinderen en een goede lichaamsgroei. Ik bespreek mijn onderzoeksvragen en introduceer het theoretisch model dat ik gebruik voor mijn verdere onderzoek. In hoofdstuk 2 bespreek ik de gebruikte data en methoden. De hoofdstukken 3, 4, 5 en 6 vormen de kern van het proefschrift. In hoofdstuk 3 onderzoek ik de relatie tussen grootmoeders en de schooldeelname van haar kleinkinderen (onderzoeksvraag 1). Hoofdstuk 4 analyseert de verschillen in de relatie tussen schooldeelname van kinderen die samenwonen met oma's van moeders en oma's van vaders kant (onderzoeksvraag 2). Hoofdstuk 5 gaat in op de relatie tussen schooldeelname van kinderen die samenwonen met hun opa en kinderen die zonder opa wonen (onderzoeksvraag 3). Hoofdstuk 6 analyseert de relatie tussen groeiachterstanden bij kinderen die samenwonen met hun oma en/of opa en kinderen die zonder oma en opa wonen (onderzoeksvraag 4). In hoofdstuk 7 reflecteer ik op mijn bevindingen door verbanden te leggen tussen de verschillende hoofdstukken ten aanzien van de rol van grootouders en het welzijn van kinderen in ontwikkelingslanden. Daarnaast beschrijf ik de bijdrage die mijn resultaten hebben geleverd aan de bestaande literatuur en geef ik enkele beleidsaanbevelingen. Tot slot ga ik in op de beperkingen van mijn onderzoek en de mogelijkheden voor verder onderzoek.

Resultaten en conclusie

Lichaamsgroei en schooldeelname zijn belangrijke indicatoren als het gaat om het welzijn van kinderen en de kansen die zij in potentie hebben voor een goede toekomst. Een groeiachterstand bij jonge kinderen kan onder andere leiden tot gezondheidsproblemen, een beperkte cognitieve ontwikkeling en een lagere productiviteit op latere leeftijd. Het is daarom belangrijk om te investeren in het opleidingsniveau van de beroepsbevolking en het terugdringen van groeiachterstanden bij jonge kinderen. Investeren in kennis zorgt voor economische ontwikkeling en draagt bij aan een verhoging van de welvaart en het groeipotentieel van een economie. Op basis van de resultaten in dit proefschrift concludeer ik dat grootmoeders in het algemeen een positieve bron zijn voor het welzijn van hun

kleinkinderen onder een breed scala aan omstandigheden. Sommige contextfactoren versterken de relatie en slechts enkele factoren verzwakken de relatie.

Wat betreft grootvaders concludeer ik dat deze relatie minder eenduidig is. De aanwezigheid van een opa is positief gerelateerd aan het welzijn van kinderen op latere leeftijd als ze naar school gaan. Voor jonge kinderen is de aanwezigheid van een grootvader niet altijd positief. Alleen in polygame huishoudens en voor jonge meisjes spelen opa's een belangrijke rol bij het voorkomen van groeivertraging. Echter, als kinderen samenwonen met een grootvader én een oom, of met een grootvader in een arm huishouden of als een kind relatief klein is bij de geboorte en er is een grootvader aanwezig, blijkt dit nadelig voor de groei van jonge kinderen.

Wat betreft de schooldeelname van kinderen, zijn grootouders in zekere mate substituten van elkaar. Elk van hen kan huishoudelijke taken op zich nemen of op andere manieren bijdragen, waardoor de mogelijkheden van kinderen om naar school te gaan worden vergroot. Echter, wanneer zowel grootmoeder als grootvader in het huishouden aanwezig zijn, neemt de individuele bijdrage van beiden af. In die situatie wordt het effect van de aanwezigheid van een grootvader zelfs negatief. Dit suggereert dat opa's geneigd zijn om in zekere mate op hun vrouw te leunen en dat grootmoeders minder energie hebben voor hun kleinkinderen als hun man ook aanwezig is. Dit hangt echter ook af van de leeftijd van de grootmoeder. Voor de schooldeelname van kleinkinderen is de aanwezigheid van een grootvader belangrijker naarmate de grootmoeder ouder is. Afrikaanse grootvaders en grootmoeders vullen elkaar dus ook tot op zekere hoogte aan. Wat betreft de lichaamsgroei van kleinkinderen heb ik een dergelijke interactie tussen grootouders niet gevonden.

Als het gaat om schooldeelname, profiteren meisjes meer dan jongens van de aanwezigheid van grootouders in het huishouden. Met betrekking tot lichaamsgroei profiteren zowel jongens als meisjes van de aanwezigheid van een grootmoeder, terwijl alleen meisjes profiteren van de aanwezigheid van een grootvader. Mijn conclusie is daarom dat meisjes meer lijken te profiteren van het leven met hun grootouders dan jongens. Dit kan te maken hebben met de in het algemeen zwakkere positie van meisjes ten opzichte van jongens in Afrikaanse huishoudens. Daardoor is er voor meisjes meer verbetering mogelijk dan voor jongens en worden extra hulpbronnen meer richting meisjes ingezet.

Het hoofddoel van dit proefschrift was het vergroten van het begrip van de manier waarop het welzijn van kinderen in sub Sahara Afrika wordt beïnvloed door de aanwezigheid van grootouders in het huishouden en de wijze waarop deze relatie wordt beïnvloed door factoren op huishoud- en contextniveau. Mijn bevindingen hebben belangrijke implicaties voor beleidsmakers die de schooldeelname en groei van kinderen op het Afrikaanse continent willen verbeteren. Grootouders die samenwonen met hun kleinkinderen en in het bijzonder groot-

moeders spelen een belangrijke rol wat betreft de schooldeelname en lichaamsgroei van hun kleinkinderen. Hun belang is afhankelijk van de kenmerken van het huishouden en de omgeving waarin grootouders en kleinkinderen samenwonen. Bij het ontwerpen van beleid gericht op het versterken van het welzijn van kinderen en de economische ontwikkeling in sub Sahara Afrika is het daarom van belang dat grootmoeders en grootvaders niet over het hoofd worden gezien.

Een van de weinige organisaties die de grootmoeders in Afrika actief ondersteunt, is de Stephen Lewis Foundation. Via lokaal gewortelde organisaties in het oostelijke deel van Afrika bieden zij (financiële) steun aan grootmoeders die voor hun kleinkinderen zorgen. Uit mijn analyse blijkt dat deze steun niet alleen moet worden beperkt tot het oostelijke deel van Afrika, maar zou moeten worden uitgebreid naar de rest van het sub Sahara Afrikaanse continent. Tot slot zouden beleidsmakers, die zich bezighouden met het verbeteren van de schooldeelname van kinderen, ook de rol van grootvaders in hun beleidsontwerp moeten meenemen.

Acknowledgements in Dutch
Dankwoord

Acknowledgements in Dutch | Dankwoord

En dan ineens is het zover en tik je letterlijk de laatste woorden van je proefschrift. Vijf jaar lang heb ik aan mijn onderzoek mogen werken. Ik heb dit onderzoek in deeltijd gedaan naast mijn baan als studieadviseur en docent bij de opleiding Economie en bedrijfseconomie. Dat ik dit onderzoek heb mogen uitvoeren, heb ik als een bijzonder voorrecht ervaren. Deze periode is ook de grootste uitdaging in mijn leven geweest tot nu toe. Vooral het laveren tussen tijd voor onderzoek, mijn baan als studieadviseur en docent, mijn gezin en sociale contacten was een flinke puzzel waarvan de stukjes niet altijd goed in elkaar pasten. Maar het resultaat mag er in mijn ogen zijn. Naast het feit dat ik veel heb geleerd, denk en hoop ik dat de resultaten van mijn onderzoek bijdragen aan een verbetering van het welzijn van kinderen en grootouders in Afrika.

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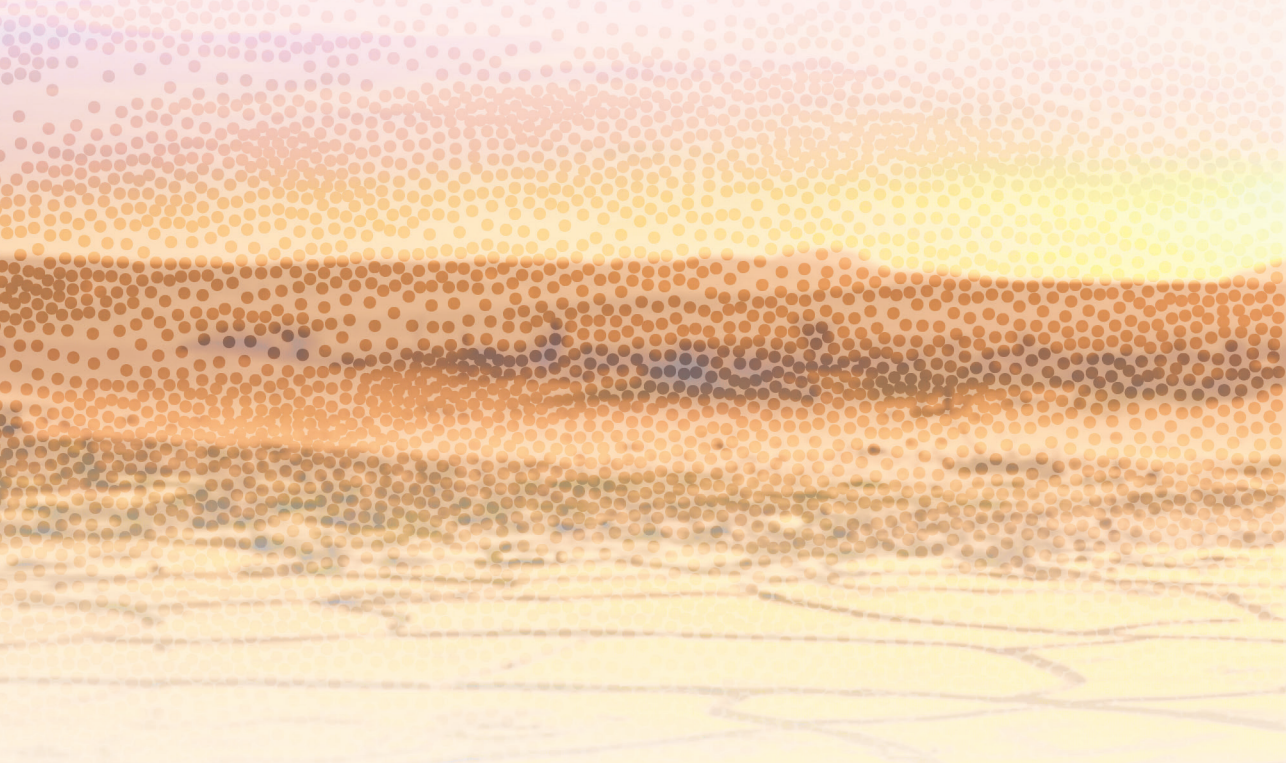
Curriculum Vitae

Curriculum Vitae

Sandor Schrijner was born on February 20th, 1973 in Arnhem (The Netherlands). He attended secondary school at the Thomas à Kempis College in Arnhem. After his graduation in 1993 he started his study of Economics at Radboud University Nijmegen and obtained his Master of Science degree in 1998. During his study period at Radboud, he worked as a student assistant at the Department of Economics. From 1998 -2001 he held the position of macroeconomic researcher at the Economics Department of ING Bank in Amsterdam. Before starting the master program of Education at Radboud University in 2003, he worked as an energy economist at Energiened in Arnhem where he was involved in the liberalization of the Dutch energy market. In 2004 he obtained his Master of Education degree and started his academic career as study advisor and lecturer at the departments of Economics. During the period 2007-2010 he also held a part-time position as student trainer at the Department of Student Affairs of Radboud University. In 2012 he was involved in setting up Radboud's first English taught bachelor program in International Economics and Business. Next to his position as study advisor and lecturer at the department of Economics he started his part-time PhD-project in 2012. His first scientific publication regarding the role of grandmothers and children's schooling in sub-Saharan Africa was recently accepted for publication in *Human Nature*.

The number of elderly people in the world is increasing, also in developing countries. Intergenerational contacts are important for both grandchildren and for grandparents. Sandor Schrijner examined the role of grandparents in relation to children's stunting and schooling. His results show that grandmothers and grandfathers in Africa are in general a positive resource for the well-being of their grandchildren. Children living with their grandmother have a lower chance of being stunted and go to school more often than children living without their grandmother. Grandfathers play a remarkably important role in polygamous households and for young girls. Their co-residence reduces the chance of being stunted. Girls generally benefit more than boys from the presence of grandparents in the household. Regarding children's schooling, grandfathers and grandmothers are to a certain extent substitutes of each other. The findings in this thesis show that grandparents should not be overlooked by policymakers who want to improve the school participation and growth of young children in sub-Saharan Africa.



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